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The Foundry Trades' Equipment and Supplies Association

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Order Books

There are so many angles from which an order book can be regarded that he is indeed a lucky manager who can leave its study to his assistants. A well-filled order book has all the elements of a game of chess, and a proper appreciation of all the factors certainly makes for both economy in works operation and ultimate increased profit. In the analysis of an order book, the first factor to ascertain is the total weight of castings on order, with sub-divisions showing the tonnages of the various mixtures to be used, as it is no economy to melt quite small quantities of special mixtures. If these mixtures are of excessive frequency the installation of a special melting plant should be considered. Next there is the question of balanced production. Will the dual exigencies of composition and quantity allow the attaching of small patterns to plates carrying larger ones? The quantities may differ, and unless a careful control is maintained stocks of unwanted castings may accumulate. The problem of whether or not the various castings warrant production by machine moulding must be considered in relation to the rest of the order book. If a certain amount of full days of production can be assured from any one pattern then so much the better, for few foundries are so organised that they carry a staff of pattern changers.

Order books not being fixed legal documents, orders are liable to be taken out of production at a moment's notice; thus provision should be made for alternative jobs to replace them in such an emergency. Then there is the aptitude of certain moulders to do well and quickly a defined class of work, sometimes not remotely connected with favourable piece pricing. The order book must be related to this factor or discontent will arise owing to excessive earning differentials showing up on Friday mornings, whilst, on the other hand, deliveries of castings carrying a "lowish" piece rate may be retarded. It is this last factor, delivery, which is quite often sufficient to upset the general production programme.

The four cardinal factors which have to be related to the order book are the metal preparation; the floor and the moulding machines; the available labour, and the time factor. For many industries and some foundries the preparation of a production schedule is reasonably easy, but for many sections of the industry it involves a daily study by all those concerned with production. The manager needs the co-operation of the foremen of the foundry, pattern shop, core making, and fettling departments. Once clearly established, the path is cleared for intelligent buying, for routing, and for partial or complete mechanisation. The action taken as a result of such conferences must reach backwards as well as forwards. Reports should be prepared to acquaint the sales department with the type of orders necessary to bring about a better balance of production, for certain orders they obtain are scarcely profitable, as they do not fit into the normal production schedule, and demand the personal attention of executive officers, whose job it is to supervise, and not to practice handicrafts. Efficiency experts would be well advised to start their labours with a correlation of the order book with rationalised production. They would learn to appreciate at a very early stage just a few of the problems which beset the ordinary foundry manager.

The Foundry School's First Session

The first session of the British Foundry School comes to a close at the end of this month, and any idea that a start with thirteen students might prove unlucky has been falsified by events, for the session has been highly successful. An opportunity to take stock will be offered on July 21, when—as announced elsewhere in this issue—the first annual meeting is to be held. The meeting is, strictly, in respect of a financial year ending March 31, a very usual date in educational circles, but it will be possible to report generally on progress virtually to the end of the session. The School has been fortunate in the co-operation it has enjoyed from firms, institutions and private subscribers, and in having had an extremely promising group of students. They have come into contact with a wide circle of people in the industry through the visits they have regularly paid to foundries and through the lectures they have had from a large number of specialists, and their keenness and ability have created a very favourable impression. We believe that the Papers set for the diploma examination will be available later to those interested, for a small charge, and the high standard aimed at will be generally realised. The existence in the industry of a body of enthusiastic young men with their special training is bound to react favourably on it, both from the point of view of technical progress and professional standards. We trust that next session a similar group may be forthcoming. As the

(*Continued on page* 38.)

Ups and Downs in Tin

By "ONLOOKER."

The tin market took badly the recent decision of the Committee to increase the quota percentage from 85 to 90 per cent., and it looked very much as if the landslide were going to knock the bottom out of the market and rattle the quotation down into the neighbourhood of £150 per ton. Above all things, the tin market is the happy hunting ground of uncertainty, and more often than not it is the unexpected that happens, to the confusion and undoing of the over-bold speculator, who discovers when it is too late that there is a flaw in his carefully-laid plans. This is just what happened recently, for following on an excellent statistical showing at the end of June, which revealed a reduction of about 2,000 tons in total visible supplies, it was announced that the arrears in Bolivian shipment this year, amounting to some 15,000 tons, had been cancelled, and after a week-end of hesitation the quotation turned up very sharply, improving by about £15 in four days. Bears rushed to cover, and bulls, believing that this new move meant a continuation of the present control scheme through 1937, bought boldly.

The elimination of the Bolivian tonnage certainly makes a difference to the outlook, but production is now up to 90 per cent., and even so stocks in this country are still dangerously low, bearing in mind the international outlook and the fact that we produce very little tin in Great Britain. This suggests that there is not likely to be any reduction in the percentage quota for the last quarter of 1936, and should American deliveries continue on the scale recorded during June, it may well be necessary to increase again. In the States the tinplate trade is enjoying something of a boom, and just before the slump in values at the end of last month consumers bought fairly heavily in the expectation that there would not be a quota increase for the current quarter. As already stated, following on the Bolivian news and the better statistics, the market recovered rapidly, and was fairly steady after the advance, but it cannot be doubted that confidence has had a rude shock, and it will not be easy to get over this. Rightly or wrongly, the impression has been created that the control has got things into a muddle, and until the situation clarifies we must expect a jumpy market with price movements unexpected and probably inexplicable. In America users are covering with caution, for they are apparently still rather sceptical about the renewal prospects.

What constitutes a reasonable level for tin is a debatable point, but at the present price producers must be earning quite good profits even though output may be cut. What they have to remember, of course, is that consumption has suffered as the result of an inflated price, for substitutes have been tried out and found to be reasonably satisfactory in their use. This inevitably happens when the price of any commodity is lifted too far and held up, although all pointers show that the wind is blowing from a stormy quarter. The copper producers found this out six years ago, and in spite of every effort and a period of unduly low values, it is doubtful whether they have yet regained all the lost ground, for once users have turned their backs on a commodity it is difficult to get them to return to it. Should the pressure of events drive tin down far enough an increase in consumption would be seen, but salvation along these lines is a painful process. From whatever angle one regards the tin situation it looks uncertain and a lower price level is likely.

IT HAS BEEN DECIDED to offer for sale 1,000,000 ordinary shares of 5s. each in the capital of Craven Bros. (Manchester), Limited, manufacturers of machine tools for the general engineering industry.

East Anglian Section's First Works Visit

The recently-formed East Anglian Section of the London Branch of the Institute of British Foundrymen made its first organised works visit on Thursday of last week, when a party of about 30 inspected the Waterside Works of Ransomes & Rapier, Limited, at Ipswich.

The visitors assembled in the works canteen, where they were welcomed by Mr. R. S. Lewis (the chief engineer), who introduced the party to the guides who were to conduct them around the various departments. The tour of the works started with the iron and brass foundries, proceeding to the erecting shops, where a very large excavator was being assembled, the machine shops, the welding department and finally a small experimental department where model sluice gates and other water control devices are tested out. After the inspection the visitors were entertained to tea.

COL. C. PORTWAY (Senior Vice-President), on behalf of the members, proposed a vote of thanks to Ransomes & Rapier, Limited, for having accorded them permission to inspect the works. It was, indeed, a notable event for the East Anglian Section, for it was the first works visit which they had made. The members, he thought, would have to go a long way to find a more interesting works than that which they had seen that afternoon. They had been given "the run of the works," and for that privilege, and for the kind reception and entertainment to tea, the visitors wished to express their great appreciation.

MR. BOOTH (of Booth & Brookes, Limited, Burnham-on-Crouch), who seconded the vote of thanks, said that those foundrymen who lived in country districts very much appreciated the opportunity of being able to visit other works. He was sure that they had all found the visit both pleasing and interesting.

MR. LEWIS briefly replied to the vote of thanks, which was carried with acclamation.

International Meehanite Metal Institute

Members of the Meehanite Institute last Tuesday were the guests of Mr. E. H. Jones, the chairman, at a dinner held at St. Stephen's Club, Westminster. Mr. V. C. Faulkner, Editor of THE FOUNDRY TRADE JOURNAL, was the principal guest, and in his talk he complimented the Institute on the ever-increasing interest shown by the members as was instanced by the fact that no less than thirty-five technical Papers had been read and discussed during the day. The Institute had indeed been fortunate in having with them Mr. Oliver Smalley, H.M. Consul at Pittsburgh, and the metallurgist who had from the inception directed the destinies of the process. As he had been the guest of the Institute on several previous occasions, Mr. Faulkner devoted the remainder of his speech to quotations from "English Trades"—a book published in 1824, which contained many fascinating references to foundry practice.

Amongst those present were Mr. John Cameron, J.P. (Past-President of the Institute of British Foundrymen); Mr. N. E. Rambush (Ashmore, Benson, Pease & Company); Mr. Gardner (Glenfield & Kennedy); Mr. Frank Hudson; Mr. F. Klouman; Mr. Pierre Charles (France); Mr. H. Field; Mr. A. Campion; Mr. E. Curry, and Mr. R. B. Templeton.

THE BRIDGE which is planned to span the River Hooghly at Howrah, Calcutta, will be built by the Cleveland Bridge & Engineering Company, Limited, of Darlington. The value of the contract is about £1,750,000.

Book Review

Foundry Calculations and Drawings. By Leslie BOOTH. Published by Charles Griffin & Company, Limited, 42, Drury Lane, London, W.C.2. Price 4s. net.

This book, which is essentially for the use of students, moulders or patternmakers, is intended "to bridge the undoubtedly wide gap between practice and theory," and as a student with no practical knowledge of foundry practice, the reviewer finds that the author has fulfilled his purpose in a clear and creditable manner.

Apart from four-figure logarithm tables, trigonometrical tables and a good index, the book is divided into seven chapters. Chapters I, II and III are a survey of elementary mathematics, including geometry, trigonometry and mechanics. As in the remaining portions of the book, the well printed text is amply illustrated by clear diagrams, and in these three chapters all formulæ required for the comprehensive study of subsequent sections are given. It will be noted that throughout this work the author, in his calculations, has used checks which may quickly be made and will undoubtedly save numerical errors from becoming serious mistakes in practice.

Chapter IV deals with the various styles of sketching and drawing and gives the reader a clear idea of the application and suitability of isometric, perspective and machine drawings. All methods may be followed on the accompanying sketches, and rules to be observed when drawing to scale are also given.

Graphs form the subject of Chapter V. Their actual construction, uses and advantages are all explained thoroughly. The next chapter, on the calculation of weights is necessarily a collection of examples the majority of which are easily followed; there are, however, one or two which are difficult to understand. It is realised that as proficiency is gained steps in one's calculations will be missed out, but it would have been much appreciated had the author explained some of his examples more fully. The determinations of areas and volumes are made not only by formulæ, but the squared paper, ordinate and mid-ordinate methods are also described.

The last chapter deals with the calculation of furnace charges, and clearly describes how various quantities of raw materials are mixed together in calculated proportions to form a product of known composition. The chapter includes the determination of the quantities of air, gases and coke required in reactions of combustion.

Although all the examples are worked out the student may, of course, work them himself and compare his method and style with those of the author. This book is strongly recommended to those requiring a work on the fundamentals of foundry practice.

J. B.

The Foundry School's First Session

(*Continued from page 37.*)

large majority of the men in the first year were nominated by their employers, it will be clear to other employers that the surest way to obtain the services of a man with the hallmark of the School is to find a suitable man and send him there. It is intended that the new session shall open in September. Many men, of course, are unable to leave their posts for as long as a year, and the possibility of holding a short course during the summer vacation has been considered by the Governors, but could not be put into effect this year. Doubtless next year the point will be further considered.

A Study of the Influence of Manganese and Molybdenum Additions to Cast Iron*

By J. E. HURST

This investigation was undertaken with the primary object of studying the influence of additions of manganese and molybdenum conjointly to cast iron.

Experimental Procedure

It was decided to study the effect of these conjoint additions when added to a cast iron of a basis composition of approximately total carbon 3.5 per cent. and silicon 1.0 per cent., and the procedure adopted in the preparation of the specimen was designed to maintain these two elements as nearly constant as possible, and to provide specimens with increasing quantities of molybdenum and manganese.

TABLE I.—*Composition of Base Pig-Irons.*

	T.C. Per cent.	Si. Per cent.	Mn. Per cent.	S. Per cent.	P. Per cent.	Mo. Per cent.	Cr. Per cent.
Pig-iron A ..	3.63	0.95	0.28	0.075	0.195	Nil	0.14
„ B ..	3.82	1.10	0.28	0.045	0.26	10.0	0.20
„ C ..	4.15	1.22	9.00	0.052	0.183	Nil	0.15

Three base pig-irons were prepared from a mixture of refined white pig-iron and ferro-alloys by melting in a cupola. The chemical composition of these base pig-irons is shown in Table I.

By melting together suitable proportions of pig-iron A and pig-iron B, a series of alloys of low-manganese content containing molybdenum from a trace up to approximately 3.5 per cent. was obtained. Three other series of seven alloys were prepared by melting together the requisite proportions of the three pig-irons and contained approximately 1.0, 2.0 and 2.75 per cent. of manganese respectively. The complete chemical analyses of the four series of specimens thus obtained are set out in full in Table II. The

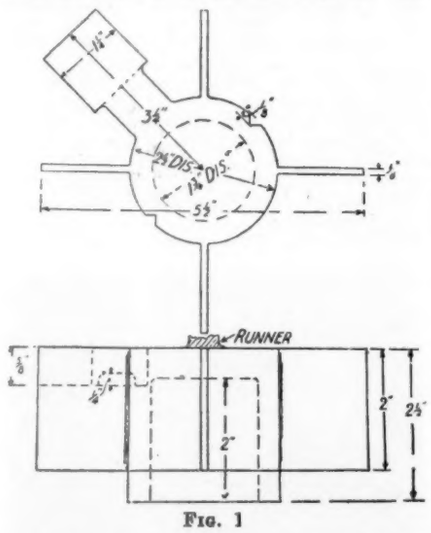


FIG. 1

whole of these specimens were prepared by melting in a high-frequency electric furnace and in the case of each individual composition one star bar and one K test-bar was cast. The test-bars were all cast in green-sand moulds. The details of the star bar are given in Fig. 1, from which it will be noticed that the cylindrical portion of this bar was cast solid instead of in the form of a hollow cylinder, as is usual with this type of bar. The K test-bar conformed to the standard dimensions.[1] The testing procedure included the examination of the bars in the "as-cast" condition, the determination of the Brinell hardness and the examination of the microstructure. The cylindrical portions from the star test-bars were subjected to an annealing treatment at a temperature of 950 to 975 deg. C., soaked at the temperature for two hours and allowed to cool slowly with the furnace.

In the annealed condition the hardness was again determined, and test-rings machined from the bars for testing in accordance with the procedure outlined in the author's previous Paper.[2] The microstructure of the annealed specimens were examined also. Brinell-hardness determinations were determined with a 10-mm. dia. ball and a 3,000-kilogramme load and the Firth diamond hardness using a 30-kilogramme load machine. No difficulty was experienced in casting the test-bars, and in all cases the alloys as melted were quite fluid and ran freely. No special precautions were taken in the provision of gates or feeder risers calculated to take care of any shrinkage and, as would be expected under these conditions, the alloys which were mostly hard showed the characteristic effects of shrinkage in the broken K test-bars.

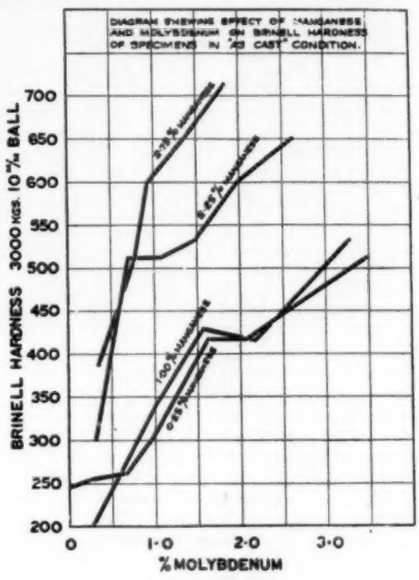


FIG. 2.

TABLE II.—*Analyses, Hardness and Fracture. "As-Cast" Condition.*

Spec. No.	T.C. Per cent.	Si. Per cent.	S. Per cent.	P. Per cent.	Mn. Per cent.	Mo. Per cent.	Hardness as cast. Centre Brinell.	Hardness as cast. Mean F.D.H.	Fracture as cast.
1A ..	3.34	0.87	0.059	0.19	0.26	0.02	248	285	Grey.
1B ..	3.32	0.89	0.062	0.19	0.25	0.26	255	278	Grey mottled.
1C ..	3.37	0.96	0.068	0.21	0.26	0.69	262	291	Grey mottled.
1D ..	3.43	0.96	0.069	0.21	0.26	0.96	302	320	Grey mottled.
1E ..	3.37	1.01	0.062	0.19	0.29	1.62	418	460	Tick white.
1F ..	3.37	1.05	0.071	0.20	0.28	2.07	418	518	White.
1G ..	3·37	1·17	0·044	0·20	0·28	3·45	512	627	White.
2B ..	3.43	0.99	0.054	0.20	1.04	0.32	196	226	Grey mottled.
2C ..	3.40	0.99	0.053	0.20	1.04	0.81	—	—	Med. mottled.
2D ..	3.43	0.95	0.062	0.19	1.00	1.00	340	352	Mottled.
2E ..	3.37	1.01	0.050	0.19	0.95	1.57	430	518	White.
2F ..	3.40	1.01	0.055	0.19	0.98	2.17	418	534	White.
2G ..	3.55	1.04	0.055	0.19	0.97	3.27	532	649	White.
3B ..	3.60	0.99	0.034	0.19	2.14	0.32	302	460	Hard mottled.
3C ..	3.49	1.03	0.038	0.19	2·23	0.70	512	518	White.
3D ..	3.55	1.08	0.035	0.19	2.17	1.06	512	551	White.
3E ..	3.49	1.17	0.025	0.20	2.16	1.49	532	627	White.
3F ..	3.49	1.05	0.025	0.20	1.96	1.98	600	627	White.
3G ..	3.55	1.03	0.015	0.20	2.22	2.61	652	774	White.
4A ..	3.60	1.10	0.026	0.20	2.82	0.39	387	390	White.
4B ..	3.61	1.10	0.022	0.21	2.65	0.76	512	551	White.
4C ..	3.60	1.05	0.021	0.20	2.72	0.78	477	587	White.
4D ..	3.68	1.08	0.020	0.21	2.86	0.91	600	627	White.
4E ..	3.63	1.24	0.015	0.19	2.78	1.36	652	671	White.
4F ..	3.71	1.05	0.010	0.19	2.83	1.82	713	719	White.
4G ..	3.60	1.10	0.012	0.18	2.14	2.78	652	832	White.

For a complete examination of the fractures the K test-bars were broken through one of the limbs of the bar, and in almost every case this yielded a sound fracture, shrinkage effects being present only at the junction of all the limbs of this test-bar. The fractures of the test-bars obtained from an examination of the K test-bars are detailed alongside the analyses in Table II.

The specimen free from molybdenum and low in manganese was mostly grey, showing a slight tendency to chill at the corners and edges. With increasing amounts of molybdenum this 1-in. square section of the K test-bars becomes harder, passing through grey mottle up to 0.96 per cent. molybdenum, beyond which it becomes white throughout. With 1.00 per cent. approximately of manganese (Series 2) the fracture in the first specimen of the series was grey mottled, probably due to the presence of 0.32 per cent. of molybdenum. Again, beyond 1.00 per cent. molybdenum the fracture changes to completely white. On the basis of the fracture the increase in manganese appears to have made very little difference, but taking into consideration the slightly higher average total-carbon content, it is probably correct to say that the fractures show a slight tendency to increase in hardness.

In Series 3 with slightly over 2.0 per cent. of manganese it is clear, in spite of the presence of 0.32 per cent. molybdenum in the first specimen of the series, that there has been a pronounced increase in hardness of this fracture, and the

* Paper presented at the Annual Conference of the Institute of British Foundrymen in Glasgow recently.

1 Cook and Hailstone, Journal of the Iron and Steel Institute, Carnegie Scholarship Memoirs, 1916.

2 Proceedings of the Institute of British Foundrymen, 1930-31, p. 375, etc.

whole of the K-bar fractures are white. With a still further increase in manganese to slightly over a mean value of 2.75 per cent. in Series 4, a still further increase in hardness of fracture is observed, the whole of the specimens being white throughout. It would appear, therefore, that in a cast iron of this composition, melted and cast in green-sand moulds under the conditions adopted in these experiments, the addition of increased amounts of molybdenum is accompanied by the tendency to produce a white fracture. With a low-manganese content of 0.25 per cent. the fracture becomes almost completely white on passing 1 per cent. of molybdenum, and with increasing quantities of manganese the tendency towards the production of a white fracture increases, and with 2.75 per cent. of this element a white fracture is obtained with 0.39 per cent. of molybdenum.

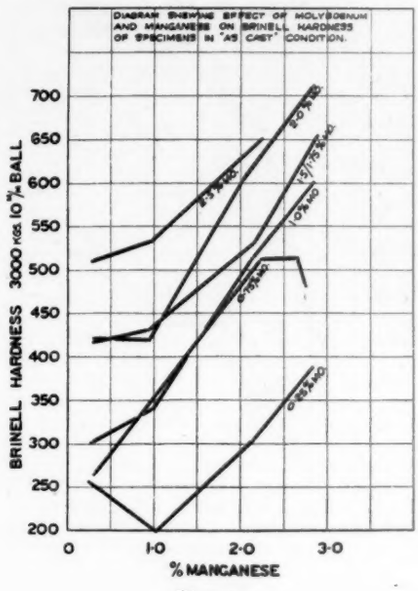


FIG. 3.

Brinell Hardness "As-Cast" Condition

The hardness values in the "as-cast" condition were determined on the cross section of the cylindrical specimen from the star test bars. These at 2.5 in. dia. possessed a substantially larger cross-section than the K test bars. Determinations were made at the outside edge and centre of the area using a standard machine with a 10-mm. diameter ball and a 3,000 kg. load. At midway between the centre and outside edge of the specimens Firth diamond hardness readings were taken using a 30 kg. load with the diamond indenter. Owing to the presence of slight chill at the outside edges of some of the specimens, the hardness results at the outside position were somewhat irregular and only the results at the centre and the Firth diamond hardness results at the mean radius are given in Table II. In considering these results in detail it will be noticed in the low-manganese series (Series 1) that increasing quantities of molybdenum do not seriously affect the hardness up to 0.69 per cent. of this element. Beyond this, there is a tendency to increase with increasing percentages up to 3.45 per cent. molybdenum.

In the case of Series 2 containing approximately 1 per cent. manganese, the marked increase in hardness again begins with 1.00 per cent. molybdenum and a similar tendency to increase in hardness is shown with increasing quantities of this element. The hardness values are also generally at a slightly higher level. This is shown more clearly in the diagram Fig. 2. The same diagram shows clearly the substantially higher level of hardness values in Series 3, containing approximately 2.25 per cent. manganese, and in this series the increase of molybdenum to 0.70 per cent. is accompanied by a very marked increase in hardness value (in spite of the difference in total carbon content, to which reference will be made later). The Series No. 4, with a slightly higher manganese content only, shows a still higher level of hardness than Series 3, in the higher molybdenum-content members of this series, but as in all the other series, it will be noticed that increasing percentages of molybdenum bring about increase in hardness and that again 0.70 per cent. of this element is sufficient to bring about a substantial increase in hardness as in the case of Series 3, 2.23 per cent. manganese.

The effect of the slight increase in total carbon contents in each series must be taken into consideration. On the basis of the mean carbon contents, which are 3.37, 3.43, 3.53, and 3.63 per cent., respectively, there is a fairly uniform increment from series to series and it would be anticipated that whilst this would increase the tendency to greyness, it would also have an effect in increasing the general level of hardness in the white condition. Whilst this is true, the results contain ample evidence that the increment in hardness level is in the greater part due to the intrinsic effect of the manganese and molybdenum, and the conclusion that increasing percentages of manganese in conjunction with molybdenum are accompanied by an increment in hardness within the limits of the percentages used in these experiments appears to be justified.

The following further conclusions are not affected by this consideration of the total carbon content, that increase in molybdenum for a given manganese content is accompanied by increase in hardness, and that with low manganese (0.25 per cent.) this effect of molybdenum is not very substantial until the percentage exceeds 0.70 per cent. In the higher manganese-content speci-

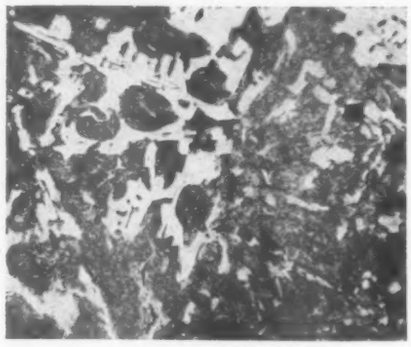


FIG. 4.—1A. AS CAST. × 250 DIAS. ETCHED PICRIC ACID.

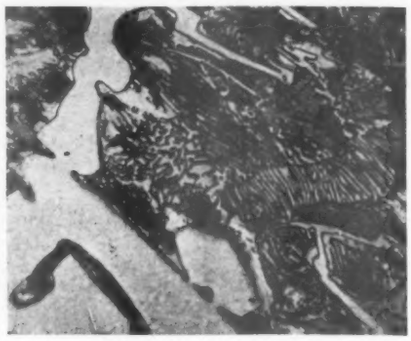


FIG. 5.—1A. AS CAST. ×1,500 DIAS. ETCHED PICRIC ACID.

TABLE III.—*Brinell Hardness at the Outer Edge and Centre of the Specimens. "As-Cast" Condition.*

Specimen No.	Hardness.		Specimen No.	Hardness.		Specimen No.	Hardness.		Specimen No.	Hardness.	
	Edge.	Centre.		Edge.	Centre.		Edge.	Centre.		Edge.	Centre.
1A	351	248	—	—	—	—	—	—	4A	477	387
1B	302	255	2B	277	196	3B	512	302	4B	532	512
1C	—	262	2C	—	—	3C	512	512	4C	—	477
1D	364	302	2D	418	340	3D	512	512	4D	555	600
1E	418	418	2E	—	430	3E	532	532	4E	—	652
1F	477	418	2F	477	418	3F	627	600	4F	—	713
1G	512	512	2G	532	532	3G	600	652	4G	552	652

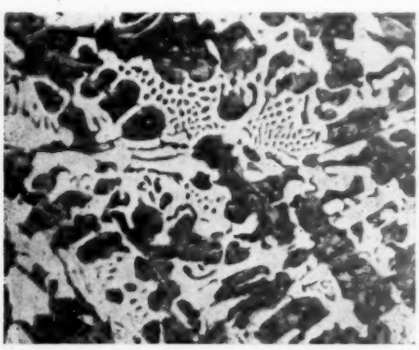


FIG. 6.—1G. AS CAST. × 250 DIAS. ETCHED PICRIC ACID.

FIG. 7.—1G. AS CAST. × 1,500 DIAS. ETCHED PICRIC ACID.

FIG. 8.—2C. AS CAST. × 1,500 DIAS. ETCHED PICRIC ACID.

mens, the increment in hardness takes place with a similar molybdenum content and with 2.25 per cent. manganese an amount of 0.70 per cent. molybdenum brings about a substantial increase. This is demonstrated by replotting the results in the manner shown in Fig. 3, using the manganese percentages as the base. The marked increase in hardness begins with the 0.75 per cent. molybdenum curve.

The extremely high hardness values obtained in the specimens containing 2.25 per cent. and more manganese and over 1.00 per cent. molybdenum are deserving of special comment. Brinell hardness values of 600 and over are obtained. These high values are confirmed by the Firth diamond hardness test and it will not be overlooked that they are obtained at the centre of the 2.5 in. dia. specimen.

The hardness results obtained at the edge and centre of the specimen are compared separately in Table III. The difference in the results in the low molybdenum-content members of the series is due to the presence of chill structure at the outside edge. In the higher members of the series the hardness becomes practically uniform across the section. Series 3 provides an excellent example of this observation.

Microstructure of "As-Cast" Specimen

The microstructure of the "as-cast" samples has been studied by means of specimens taken from the K test bars. In all cases the specimens have been etched with picric acid and the specimens were examined at magnifications of 250 and 1,500 diameters respectively. The structures in the low manganese Series 1 consist of carbides and a pearlite background. The photographs of the specimens 1A and 1G at magnifications of 250 and 1,500 are illustrated in Figs. 4 to 7. Specimen 1A containing no molybdenum shows the normal structure of carbides and pearlite and some graphite, and in 1G the increased quantity of carbides and the pearlite matrix is clearly shown. With the increased amount of manganese in Series 2 the carbides are still present and the matrix loses its marked pearlite character and a further constituent appears in the structure, increasing in amount with the amount of molybdenum present.

The photographs Figs. 8 and 9 at 1,500 diameters show specimens 2C and 2G, the greater part of the matrix in 2G being composed of this constituent. Figs. 10 to 13 show respectively the specimens 3F and 4G. From an examination of 4G at 1,500 diameters almost the whole of the matrix appears to be martensitic and whilst not very clearly resolved in the photograph, the additional constituent in the various specimens appears to be martensitic in character. It appears therefore that the conjoint additions of molybdenum and manganese bring about the formation of a martensitic structure increasing in amount with increase in the joint addition of the elements.

With a manganese content of 0.25 per cent. (0.25 to 0.28 per cent.), the microstructures show that with increments of molybdenum up to 3.45 per cent. the structures still remain essentially pearlitic. The general increase in hardness noted in this series is due in the main to the increased amount of carbide constituents which are shown in the photographs and which confirm the observations of the fractures of the specimens. An increment of manganese to the neighbourhood of 1 per cent. in Series 2 is accompanied by a decided change in the character of the pearlite matrix, which becomes finer and much more difficult to resolve. Some of the martensitic constituent begins to make its appearance and with 0.81 per cent. molybdenum and 1.04 per cent. manganese this can be clearly identified and with further increment in molybdenum up to 3.27 per cent. the amount of martensitic constituent in the structure increases substantially. This is clearly evident from the photomicrographs. With still higher percentages of manganese and molybdenum the martensitic character of the structure increases, a fact which explains the higher hardness values attained in these higher alloy content series.

From an observation of the micro-structure, the diagram Fig. 14 has been constructed in an endeavour to illustrate diagrammatically the relation between the conjoint percentages of molybdenum and manganese and the appearances of the martensitic structures. The specimens were examined carefully with the object of ascertaining the approximate percentage of martensitic constituent visible. These observed percentages plotted in relation to the manganese and molybdenum content yield a series of zones. It will be appreciated that the percentages indicated by the various zones are approximate only.

In considering extrapolation in the direction of no manganese, it will be noted that no martensitic constituent was observed in any of the

(*Continued on page 42.*)

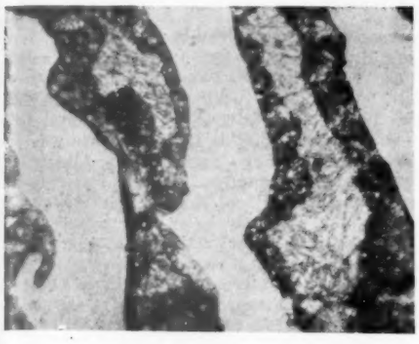


FIG. 9.—2G. AS CAST. × 1,500 DIAS. ETCHED PICRIC ACID.

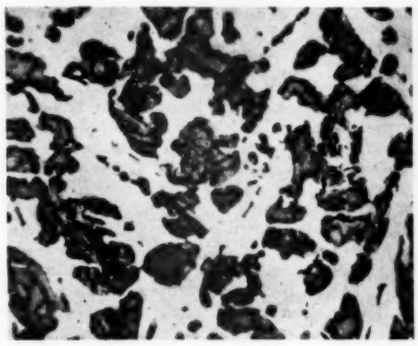


FIG. 10.—3F. AS CAST. × 250 DIAS. ETCHED PICRIC ACID.

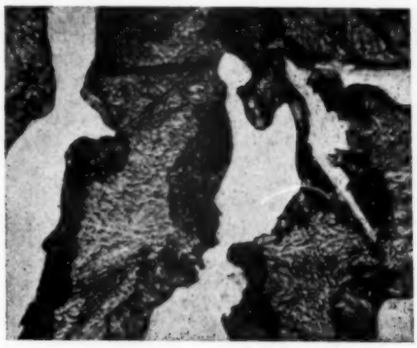


FIG. 11.—3F. AS CAST. × 1,500 DIAS. ETCHED PICRIC ACID.

FIG. 13.—4G. AS CAST. × 1,500 DIAS. ETCHED PICRIC ACID.

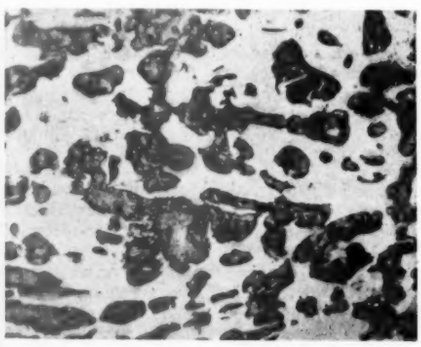


FIG. 12.—4G. AS CAST. × 250 DIAS. ETCHED PICRIC ACID.

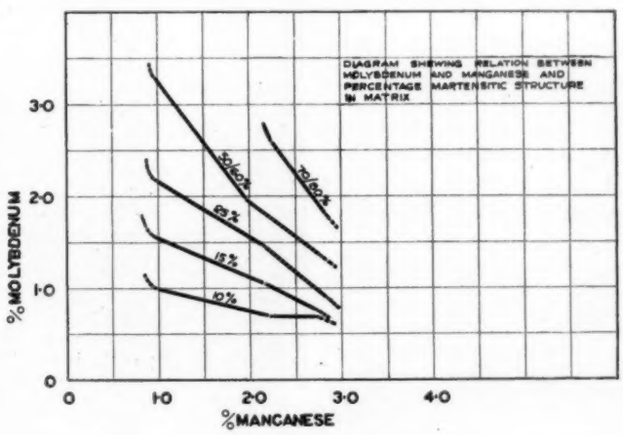


FIG. 14.

Electric Furnaces

THEIR CONTRIBUTION TO METALLURGICAL PROGRESS

At a meeting of the American Iron and Steel Institute held recently in New York, MR. FRANK R. PALMER read a Paper on "Electric Furnaces and their Part in Metallurgical Progress" in the course of which he said that the bulk of all electric-furnace steel used to-day was melted in the basic Heroult type of furnace. Electric furnaces were unique in that there was no need for an oxidising atmosphere to support fuel combustion. Since many of the useful elements in steel, such as carbon, manganese, silicon, chromium, etc., were readily oxidisable at steel melting temperatures, they obviously could not be conserved in the bath under oxidising furnace conditions. With the neutral or reducing conditions that could readily be produced and maintained in the electric furnace, many of these oxidisable elements could be held constant in the bath for long periods. Time was allowed to send samples to the control laboratory for exact analysis and then, by "dead reckoning," alloy additions could be made in order to arrive at the composition desired. The high-frequency induction furnace had still another advantage which might bear upon the subject of accurate analysis, especially in the very rich alloy steels. That advantage was the rapid stirring action set up in the bath by the induced currents.

The balance of alloys present, continued the author, often determines how close a particular element can be maintained. Consider metalloids like sulphur and selenium, both of which are being deliberately added to electric-furnace steel for free-machining properties. Aiming for 0.25 per cent. selenium, it would be easy to work to the limits of 0.20 per cent. to 0.30 per cent. if the manganese is less than 0.50 per cent. However, if an attempt is made to add these same metalloids to Hadfield's manganese steel, the loss of metalloid is so rapid as to be completely out of control.

Phosphorus is removed under oxidising conditions in a basic furnace, hence the electric-arc furnace has no particular advantage over the open-hearth furnace except that because it is customary to employ lower phosphorus melting stock in the electric furnace, the final content is generally lower. Sulphur yields slightly to an oxidising condition under a basic slag, but it can be substantially eliminated only under reducing-atmosphere conditions. This was one of the earliest advantages claimed for the electric-arc furnace.

Phosphorus and sulphur limits cannot be practically arrived at without due consideration of the rest of the analysis. The high-frequency induction furnace, like the crucible melting process, has no capacity to eliminate either phosphorus or sulphur. In this process the raw materials used determine the ultimate composition.

Cleaner Steel

Clean steel is not necessarily guaranteed by electric-furnace melting, because the non-metallics that appear in "dirty" steel do not all originate in the furnace; a considerable part may come from ladle or spout refractories or result from dirty mould practice. Within the past 20 years there has developed a pressing demand among steel users for cleaner steel, not only in tool steel, but also in the structural alloy steels. Manufacturers of aircraft, pneumatic tools, anti-friction bearings, machine tools, motor cars, and almost innumerable other equipment have varied only in the degree of their specifications. They all want cleaner steel, and the hot-acid etch test gives them a means of inspection to ensure their getting what they want. Progress in making cleaner steel has not been monopolised by the electric furnace, but electric steel has gone much farther than any other and is the only practice available to meet the most stringent specifications.

In so far as clean steel is made inside the melting furnace, the degree of success depends upon deoxidation and the removal of sulphur, both of which can be accomplished by the electric furnace. If the steel is not properly deoxidised by the slag, some of the silicon will be converted to the oxide (silica) and the metals like iron, manganese, chromium, etc., will also be oxidised in a degree. The metallic oxide combines with the silica to form the glassy slags such as iron silicate, manganese silicate, chromium silicate, etc. As these are being continuously formed in an oxidised bath, they never get a chance to float out. Sulphur always exists in the final product as a metallic sulphide which is a slag-like inclusion. These sulphides are soluble in the molten steel and are precipitated only at the moment of solidifying in the mould.

In making clean steel, the electric process depends upon its ability to work under a reducing atmosphere and a reducing slag. Not only do these deoxidise the metal and inhibit the formation of silicates, but they remove a large part of the sulphur and decrease the sulphides proportionately. The smaller average size of electric furnaces is again a big help. It is easier to avoid slag contamination of the metal after tapping when handling a few tons of metal than it is when handling a hundred tons or more.

Steels Rich in Alloys

Large percentages of alloys can be added directly to the electric melting furnace with comparatively little loss. Such heavy additions to the ladle would be impracticable or impossible but they are only everyday routine under the reducing atmosphere of the electric furnace. The abilities of the electric furnace along this line have gradually broken down certain very practical and understandable prejudices in the steelmaker's mind. Many are to-day making metals containing as much as 85 per cent. alloy and only 15 per cent. iron. The contribution of electric furnaces to the making of alloy-rich steels is not limited to their ability to make them in large quantities. The fact that this process can economically remelt the scrap from these same alloys is in itself an important contribution. For example, high-chromium, corrosion-resisting steel scrap is most unwelcome in an open-hearth charge.

Still another related advantage of the electric arc furnace is its ability to derive alloys direct from their ores. This has been done with tungsten, vanadium, molybdenum and others, but the one likely to become most important is chromium. It is entirely practicable to make corrosion-resisting steels containing, for example, 18 per cent. chromium by reducing chrome ore in the steel-making slag so that the metallic chromium is assimilated direct by the bath. A very interesting manipulation recently proposed is to feed the alloy ores into the bath through hollow electrodes.

Readily-Oxidisable Elements

Rapidly-oxidisable elements are closely related to the foregoing, but warrant separate treatment. Within the past ten years there have come into use certain alloying elements which are so readily oxidisable that their use was previously considered impracticable. Aluminium, selenium, and titanium are typical of this group. An unexplored field which the electric furnace may presently be called upon to enter, is the melting under artificial and controlled atmospheres, or in a vacuum.

Concluding, the speaker mentioned that in 20 American plants producing ingots there were two furnaces over 50 tons, seven furnaces between 25 and 50 tons, 12 furnaces between 10 and 25 tons, and 38 furnaces between 5 and 10 tons. Quite independent of the size of the shells, however, there has been a marked increase in melting efficiency due to electrical and mechanical improvements in the furnace. Voltages have been increased and variable voltages made available to the melter. It is not uncommon to find modern furnaces equipped with electrical substations from three to five times as powerful as would have been used on the same size furnace 20 years ago. The effect of these improvements may be indicated by citing one example. A certain steel mill reported in 1920 that four Heroult furnaces had an annual ingot capacity of 17,000 tons. Since that time, one furnace has been dismantled, yet in 1935 the capacity of the remaining three furnaces is said to be 32,000 tons of ingots. Thus three furnaces are almost doubling the output of four furnaces in the short space of 15 years.

A Study of the Influence of Manganese and Molybdenum Additions to Cast Iron

(*Continued from page* 41.)

specimens containing 0.25 per cent. manganese. It is probable that the lines would turn sharply in a vertical direction and that until the manganese is in the neighbourhood of 0.5 to 0.75 per cent. even traces of martensite constituent cannot be expected. The slope of the lines is sharp in the direction of the higher manganese contents, bringing the zone of martensitic constituent sharply down into the region of low molybdenum content. As the diagram stands, the probability is that 3.5 per cent. of manganese would require something less than 1 per cent. molybdenum to ensure at least 70 per cent. martensitic structures. It is worth while to remember that these specimens were all sand-cast and the structural character appears to be uniform across the section of the cast bars.

(*To be concluded.*)

Catalogues Received

Power Transmission. A folder received from Williams & Womersley, Wakefield, carries a series of illustrations of plummer blocks, pulleys, collars shafting and the like.

Cycle Parks. We are always enthusiastic about any development which makes for orderliness in and about a works, and the receipt of a catalogue from Constructors, Limited, of Erdington, Birmingham, served to remind us that much still remains to be done by a large number of foundries to make the parking of cycles a workmanlike job. In this catalogue is disclosed a number of systems for the rational storing of cycles for use by either works or public authorities. We approve of the recommendation not to use the two-tier models where ample space is available, as to lift cycles 51 to 53 inches is too high for female and boy labour.

Refined Pig-Iron. A brochure received from the Barrow Hæmatite Steel Company, Limited, Barrow-in-Furness, carries the characteristic, normally to be associated with this class of trade literature, of being definitely reliable metallurgically and free from exaggeration. In addition it is splendidly produced, the micro sections and fractures being excellent examples of the dual art of photography and printing. The brochure contains 32 pages and is admirably illustrated. Six grades of pig-iron are dealt with and after this a short and elementary but authentic description is given of the rôle which the various elements play in cast-iron metallurgy. The last section contains an outline of the manufacture of malleable iron castings, the major portion of the space available being devoted to the whiteheart process. This brochure will be sent to our readers on request.

Airless Sand-Blasting

AN INTERESTING NEW PROCESS

One of the striking features of the foundry trade during the past few years has been the rapid rise to popularity of a new type of sand-blasting machine, in which the stream of sand or abrasion is directed upon the work by centrifugal force instead of (as formerly) by compressed air. The centrifugal effect is obtained in all such machines by different forms of impellers or vanes rotating at high speeds, very much on the same lines as a high-pressure fan, while the used abrasive is again fed to the hopper above the impeller by means of a suitable form of bucket elevator. In this country, it is somewhat difficult to state to what extent the new system has made headway, owing to lack of statistics, but it is firmly established in the United States, where approximately 250 installations of the centrifugal type of sand-blaster have been installed since the beginning of 1933, while in Germany the new type has made even greater headway, and there are now over 300 of such machines at work in that country.

Drawbacks of Early Designs

Although the greatest development of this type of machine has taken place during the past three years, the principle is very much older than this. Numbers of patents covering various applications of the system were issued during the 'nineties, and some of these now make interesting reading, especially in connection with the large size of impellers that were originally envisaged for the work. The great drawback of the early centrifugal machines was the excessive wastage which occurred of the quartz sand used as the abrasive material, due to the pulverising action of the impeller blades. In the attempt to reduce the wastage of sand, the impeller speed was often reduced, but as this was naturally followed by a proportionate decrease in the output of work, this had to be abandoned. With the advent of modern steel shot and more resistant materials, as well as improvements in the design of impellers, this drawback has to a large extent been overcome, and the up-to-date centrifugal machine with direct-coupled motor drive now compares favourably with the compressed-air machine as far as the consumption of shot is concerned.

Advantages

With this early drawback removed, the advantages of the centrifugal machines in other directions become strikingly apparent, the most important of them being the very considerable reduction in power required for their operation. The saving in this respect varies somewhat according to the types of machines that are being compared, but for general purposes it may be taken that for a given output per hour and for an equal class of finish, the power absorbed by a centrifugal sand-blasting machine is between 10 and 20 per cent. of that taken by the compressed-air type. Economies in maintenance charges are approximately in the same proportions. The only wearing part in a centrifugal machine needing frequent renewal is the impeller blades, which in general cost only a few shillings, and this charge can be set against the cost of the renewal nozzles which are necessary with the compressed-air type.

The simplified construction of the centrifugal machine is in most cases reflected in a much lower first cost. This is mainly due to such costly items of equipment as the air compressor, electric motor, air receiver, and piping being replaced by a simple impeller and casing, while the small electric motor required to drive this is only approximately one-fifth, or with certain makes only one-tenth, the power of the motor needed for the compressor.

Minor Advantages

Although the foregoing summarises the main advantages which the centrifugal machines have to offer, there are also certain minor ones. There is, for instance, with the new machines no trouble such as it occasionally experienced with compressed-air plant owing to moisture in the air or the abrasive casting rusting-up of the nozzles or small passages. The small amount of dust produced by the centrifugal machine is also a noteworthy feature.

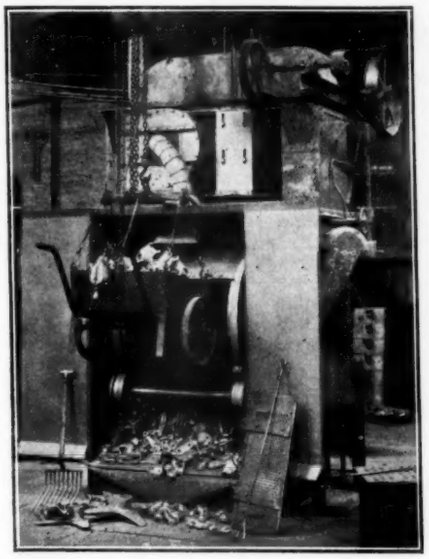


FIG. 1.—AN AIRLESS CENTRIFUGAL SHOT "BLAST" TUMBLING BARREL INSTALLED IN A LARGE BRITISH MALLEABLE FOUNDRY.

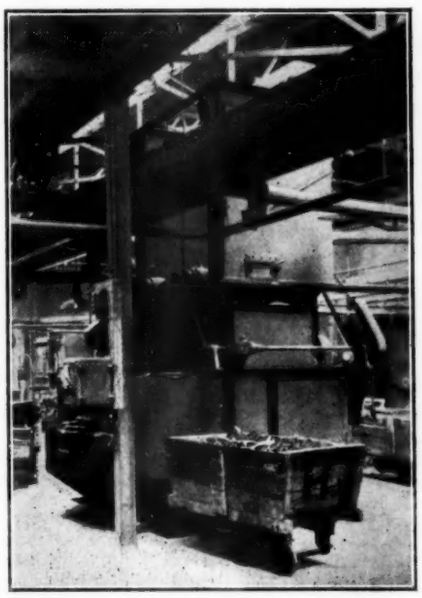


FIG. 2.—IN THIS ROTARY PLANT NO COMPRESSED AIR IS USED. INSTEAD CHILLED SHOT IS DIRECTED UPON THE CASTINGS BY CENTRIFUGAL FORCE FROM AN IMPELLER.

Output

The centrifugal machines are made both of the usual tumbler (Fig. 1) and rotary-table (Fig. 2) types, and the system has even been adapted to special machines with conveyor tracks for continuous working. Loads of castings weighing 16 cwts. can by this system be cleaned in 8 minutes, while 18-cub.-ft. loads of forgings and stampings are cleaned in 10 to 15 minutes. In the case of castings for vitreous enamelling, these require from 12 to 25 minutes in the barrel of the tumbler-type machine, according to the class of finish required.

The photographs show two types of centrifugal machine supplied by the Constructional Engineering Company, Limited, Titan Works, Birmingham, and operating upon the principle described.

Aluminium Castings

MATERIAL SPECIFICATION

The Air Ministry has issued Material Specification D.T.D.298*, for aluminium alloy sand or die castings (not suitable for pistons). This specification covers the material generally known as NA 225/W91 alloy. We append some of the principal clauses.

Quality of Material.—(*a*) The aluminium used for making this alloy shall be in accordance with the latest issue of British Standard Specification No. L.31. (*b*) The copper used shall be of a standard of purity equal to that of electrolytic copper. (*c*) No scrap shall be used other than that derived from the maker's own manufacture.

Chemical Composition.—(*a*) The chemical composition of the castings shall be:—Copper, 4.0 to 4.6 per cent.; silicon, 0.9 per cent. (max.); iron, 0.7 per cent. (max.); titanium, 0.25 per cent. (max.); impurities (including nickel, magnesium, manganese and zinc), 0.2 per cent. (max.); aluminium, the remainder. (*b*) Unless otherwise agreed with the Director of Aeronautical Inspection, the complete analysis of the castings shall be supplied to the Inspector.

Heat Treatment.—(*a*) The castings shall be delivered in the heat-treated condition. (*b*) The castings and test samples shall be heated together at a temperature of 525 deg. to 545 deg. C., for 12 to 16 hrs. and quenched in water at a temperature of 80 deg. to 100 deg. C. (*c*) The test samples shall not be further heat-treated before testing.

Preparation of Test Samples.—The metal for the test samples shall be taken directly from the same crucible or ladle of metal from which the casting or castings will be poured. The metal so taken shall not be subjected to any treatment other than cooling down to the appropriate temperature. The test samples shall be cast in dry sand moulds of specified dimensions. The mould shall be rammed in one piece; it shall be inclined at an angle of 30 deg. from the vertical during pouring and shall be poured from the top. *Note.*—The temperature of the mould immediately prior to casting should be between 10 deg. C. and 40 deg. C.

Tensile Test.—(*a*) The test pieces prepared as specified, must comply with the following test which shall be carried out to the satisfaction of the Inspector. The load shall be applied axially. (*b*) When tested they must give the following result:—Ultimate tensile stress, not less than 14 tons per sq. in.; Elongation, not less than 7 per cent.

SOUTH SHIELDS TOWN COUNCIL has approved a £200,000 scheme to reorganise the town's electricity supply. It has accepted the tender of A. Reyrolle & Company, Limited, of Hebburn-on-Tyne, for switchgear for the first portion of the scheme, which is to cost £33,000.

* H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. (Price 1s.)

Determining Clean Steel

"FOX" INCLUSION COUNT METHOD

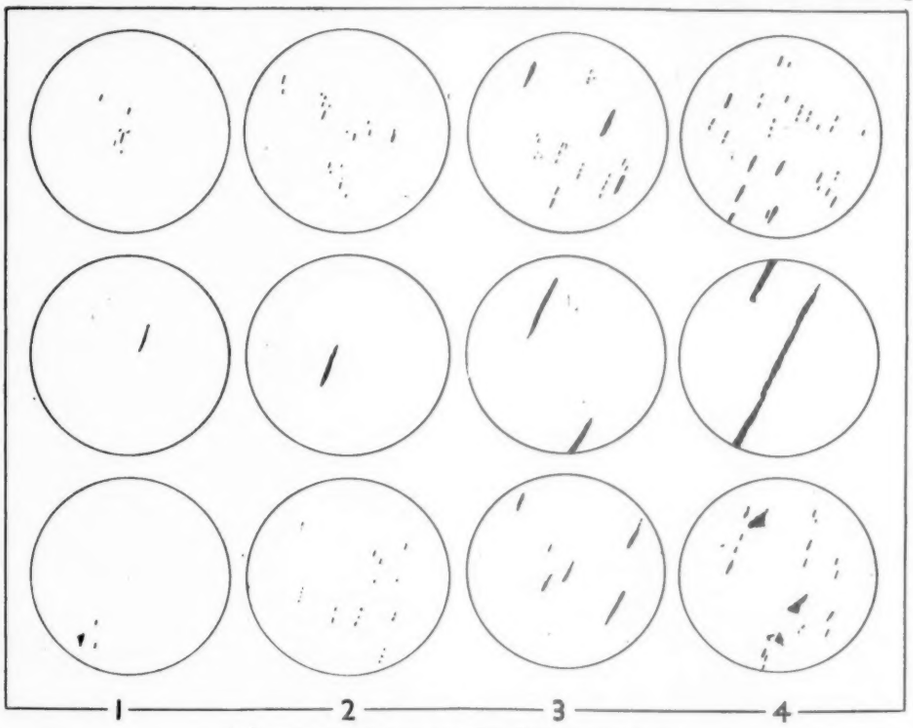
A system devised by Mr. G. R. Bolsover and adopted by Samuel Fox, Limited, associated with United Steel Companies, Limited, has been developed as a practical means of quantitatively determining the degree of cleanness of steel during routine production of their "Diamet"-inspected steels. Hitherto steel has been described as clean, dirty, or various intermediate stages between these extremes, based on the impression formed by the individual who has examined one or more samples taken as representative; this being the only means available other than those involving so much elaboration as to be unacceptable as a test coming within the scope of an ordinary routine laboratory.

For examination purposes representation of the complete ingot section is obtained by taking a sample from the top, middle and bottom of the ingot; each sample is forged or rolled into a bar 1⅜ in. dia., from which is cut a convenient length, say ½ in., and this is sectioned longitudinally through the axis of the bar. The sawn face is then prepared for micro examination in the ordinary manner, after the specimen has been fully quenched in order to obtain the hard condition, which gives a truer picture of the inclusions, with less liability to dragging or pitting during polishing. Examination from edge to edge of the specimen, *i.e.*, across the axis, gives a picture representing a complete cross-section through the axis of the ingot, and in order to minimise any possible discrepancy by the examination of a single plane the sample is examined on two such lines.

Standard Magnification

By the adoption of a standard magnification of 130 diameters, a complete traverse of the section involves approximately 30 fields, this number having been taken as a standard. The examination of two different lines, as just described, results in the inspection of 60 fields for each specimen or sample.

In order to establish a quantitative basis for the correlation of the various results, a set of micrographs has been prepared, representative of the range of inclusion groups found in steel of various types, and these micrographs have been graded 1 to 4 in increasing order of severity of non-metallic matter. Of the 60 fields examined, the number of fields corresponding with each grade is multiplied by the grade number and the sum of the products of all the fields is adopted as the inclusion number for the sample of steel examined. Obviously this inclusion number will increase with increasing quantity of non-metallic inclusions, and the following example will explain more clearly the basis of assessment of the inclusion number.



A REPRESENTATION OF THE FOX INCLUSION CHART.

Fields Examined = 60.		Inclusion Count.
Grade 0 ..	18	18 × 0 = Nil
,, 1 ..	30	30 × 1 = 30
,, 2 ..	10	10 × 2 = 20
,, 3 ..	2	2 × 3 = 6
,, 4 ..	Nil	4 × Nil 0
		Total 56
	Inclusion Number = 56	

It should be pointed out that in determining the grading for any particular field there will necessarily be, at times, some variation on either side of a particular number. Fields judged to correspond with less than half the quantity of inclusions indicative of Grade 1 are counted as "0" while from half Grade 1 up to inclusions midway between "1" and "2," *i.e.*, 1½, will be counted as Grade 1. From 1½ to 2½ is assessed as Grade 2, and so on.

In the set of micrographs used as standards and reproduced herewith, each grade number includes three different micrographs, this having been done in an attempt partially to cover the variations in type and grouping of the non-metallic inclusions which occur in different steels. Again, the inclusions illustrated are essentially of the plastic type, and where a group of brittle inclusions is met with, this, for purposes of examination, is classified as if the units of the group were linked together to form a single plastic inclusion of total length equal to that of the group. The adoption of micrographs to cover all the possible variations of inclusion type would be so confusing as to render the system unworkable, whilst working with the illustrated standards the method has been found to work exceedingly well for the examination of literally thousands of different specimens.

Naturally, it is preferable to maintain standard conditions regarding the size of bar and the magnification employed, but consideration of the possible variants, confirmed by actual checking in the laboratory, indicates that appreciable latitude can be permitted in the particular conditions applied. For instance, an increase in the magnification gives a reduction in the number of non-metallic particles in a particular field, though the size of these will be increased. As the essential of this system of examination is the assessment of the quantity of non-metallic relative to the steel as a background, provided sufficient of the section is examined, this should lead to the same inclusion number being determined. Further, if 60 fields in a 6-in. bar were examined instead of the same number in a 1⅜-in. bar a similar result should be obtained. It will be realised that some slight, though minor, differences must arise by introducing the variations mentioned, since the comparisons would be absolutely true only if the quantity of non-metallic varied proportionately with the numbering of the grades. It has not been found advisable to adopt a grading of increasing the numbers proportionately with the inclusions, since, firstly, by such a system all types of non-metallic inclusions groups could not be included and, secondly, it is doubtful whether the properties of the steel vary proportionately with the total size of given groups of inclusions found.

Copper-Beryllium Alloys

A recent study at the National Bureau of Standards, Department of Commerce, of the linear thermal expansion of copper-beryllium alloys shows that while the coefficients of expansion of various alloys containing up to 3.03 per cent. of beryllium, do not differ by more than 8 per cent. from the coefficient for copper, the differences in hardness, tensile strength, elongation and reduction of area are much greater. The tensile strength of copper-beryllium alloys may be more than four times as great as the tensile strength of copper. The changes in length, density and volume for both the quenched and the hard drawn alloys are somewhat larger than the small changes noted for the aged alloys. The changes in length, volume and density of quenched copper-beryllium alloys depend upon the temperature and the time of ageing. The density of copper-beryllium alloys decreases with increase of beryllium. The results, when plotted, bring out the fact that the expansion curves of quenched copper-beryllium alloys containing 1.33 and 2.14 per cent. beryllium, pass through critical regions which may be associated with structural changes accompanying ageing. The stabilisation of these alloys may be accomplished either by tempering or by cold working.—"Iron Age."

Cleveland Blast-furnacemen's Wages

The official ascertainment for the second quarter of the year reveals that the net average realised price of No. 3 Cleveland G.M.B. pig-iron during that period was 61s. 3.4d. per ton, compared with 60s. 3.9d. per ton in the first quarter of the year. This means that as from July 5 the wages of the Cleveland blast-furnacemen have been advanced by one per cent. to 11.25 per cent. above standard.

The Influence of Wall-Thickness on the Mechanical Properties of Cast Iron

By H. JUNGBLUTH, Essen

[GERMAN EXCHANGE PAPER.]

(*Concluded from page* 23.)

(b) Castings

However interesting and important investigations on test bars may be, it is natural that investigations on the sectional sensitivity carried out on the castings themselves are of far greater importance. The difficulty of such investigations is, firstly, that the differences in the properties of different wall thicknesses are on the whole smaller and besides depend closely on the shape of the castings. In spite of these difficulties it is imperative to attack this important problem, although it is realised that only partial solutions, and these even only approximate ones, can result.

It is logical to supplement the fundamental investigations on the effect of sectional sensitivity in the case of test bars of unalloyed material, with those on simple castings of unalloyed cast iron. But, unfortunately, the number of the observations available is much smaller than is the case with test bars.

E. Dübi[40 51]* has published two interesting Papers, already referred to, bearing on this subject. He cast box-shaped test castings of 30 mm., 50 mm., 60 mm. and 70 mm. wall thick-

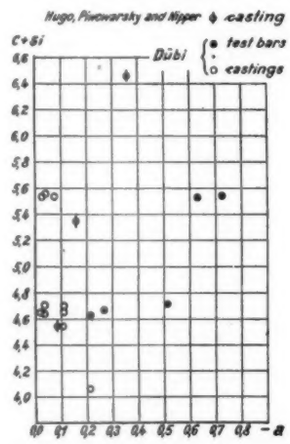


FIG. 10.—RELATIONSHIP BETWEEN C + SI AND *a*, DETERMINED ON CASTINGS AND TEST BARS RESPECTIVELY.

ness and between 650 mm. and 2,200 mm. in length, the inner core being in most cases 100 mm. by 100 mm., but occasionally 300 by 300 mm. and 300 by 600 mm. respectively. With the same composition of iron he also cast test-bars of 30 mm. and 50 mm. in diameter and, *inter alia*, determined the relevant tensile and transverse strengths as well as the Brinell hardness. The results obtained with the test bars have already been discussed above. Of the twelve castings investigated, only on the first one was the effect of all four wall thicknesses studied, and the logarithmic law satisfactorily confirmed, thus indicating that it is also valid for castings. For the other eleven specimens only the strength for a wall thickness of 30 mm. and 70 mm. is given, so that, as with the test bars, the tangent has to be drawn on the basis of two points only. In Table V and Fig. 10, the *a* values of the ten specimens are given. The two missing ones were positive. For comparison purposes the *a* values of the corresponding test bars are also included. It is again seen that the *a* values of the boxes are much smaller than those of the single bars. However, considering the very moderate number of values, no attempt can be made to determine a relation between the *a* values of the test bars and those of the castings.

The following remarks regarding the accuracy of this work are of interest. It can be taken for granted that with cast iron the greatest accuracy which can be obtained in determining the tensile strength does not exceed ± 1,067 lbs. per sq. in. (0.75 kg. per sq. mm.), *i.e.*, an overall range of 2,134 lbs. per sq. in. (1.5 kg. per sq. mm.).* A difference in tensile strength of 2,134 lbs. per sq. in. (1.5 kg. per sq. mm.) with a wall 30 mm. or 70 mm. thick, corresponding to a sectional insensitivity, has an exponent *a* of – 0.09. From the ten casts of Dübi six are below this value, and are thus not affected by the wall thickness. Only four are above – 0.09, namely, one with – 0.098, a second one with – 0.103, a third with – 0.108, and a fourth with – 0.210. In reality only the fourth shows an appreciable difference in the tensile strengths of walls 30 mm. and 70 mm. thick, viz., 6,686 lbs. per sq. in. (4.7 kg. per sq. mm.); with the third, the material with the highest exponent, the difference amounts only to 3,128 lbs. per sq. in. (2.2 kg. per sq. mm.), and therefore is just beyond the limit of experimental error. And just the material with the highest *a* value has the lowest content of C + Si. It is thus not possible to establish a definite relationship between the C + Si factor and the exponent *a*, as was the case with test bars. Furthermore, no systematic connection appears to exist between the dimensions of the castings and the exponent *a*, at least within the range investigated by Dübi.

In Fig. 10 three values are also included from the work of Hugo, Piwowarsky and Nipper[50 53] (to be discussed below), obtained with unalloyed material with a normal phosphorus content. A glance at the diagram shows a satisfactory differentiation, as compared with Dübi, although the latter did not go up to C + Si contents of about 6.45 per cent. Whether the reason for the better differentiation is to be sought in the fact that Hugo and his collaborators used shorter (450 mm.), but wider (300 by 300 mm.) castings in their investigations cannot be established with certainty. As far as the *a* values are concerned, Dübi's castings Nos. 10, 11 and 12 indicate something of this kind, although the values for Nos. 7, 8 and 9 do not confirm this assumption. In these circumstances no attempt can be made to utilise the exponents *b* and *c* for Dübi's casts in the subsequent critical analysis.

However unsatisfactory the results obtained from Dübi's data may be, although these were assembled and collated with every care and are of extreme interest, at least one important fact

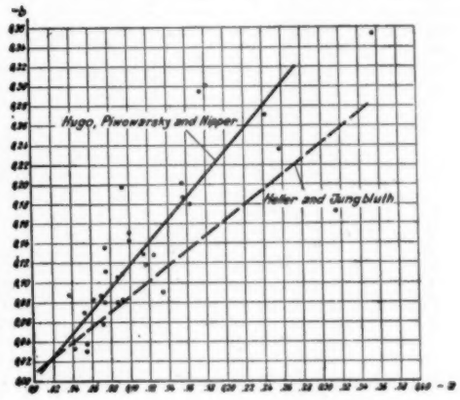


FIG. 11.—RELATIONSHIP BETWEEN EXPONENTS *b* AND *a*.

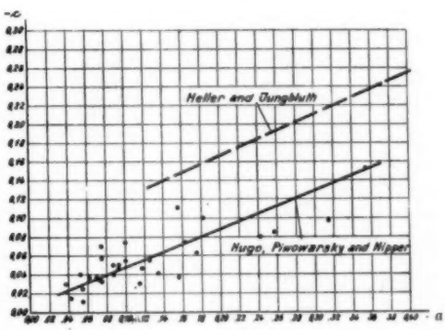


FIG. 12.—RELATIONSHIP BETWEEN EXPONENTS *c* AND *a*.

can be gleaned from this work. In a great many cases the sectional sensitivity of actual castings appears to be very small, if not altogether insignificant, this being an important practical conclusion. This statement is, moreover, confirmed by a co-operative investigation carried out by the Cast Iron Committee of the Verein deutscher Eisenhüttenleute under the chairmanship of the author, regarding which full details cannot be furnished in this Paper, since the investigations are still in progress.*

As was the case with the test bars, the investigations of Dübi on unalloyed material are supple-

TABLE V.—*Wall-thickness Exponents "a," "b" and "c" for Box-shaped Castings from Work by E. Dübi.*[40 51]

No.	C + Si.	Dimension in mm.	– *a*.	– *b*.	– *c*.	Classification of Dübi.[51]
1	4.70	190 × 220 × 650	0.036	0.072	0.016	Group A b
2	4.70	190 × 220 × 2,200	0.103	–0.128	0.000	,, A c
3	4.70	190 × 220 × 2,200	–0.208	0.120	0.000	,, A c
4	4.06	193 × 220 × 2,200	0.210	0.073	0.000	,, B a
5	4.56	191 × 221 × 2,200	0.098	–0.087	0.000	,, B b
6	5.46	190 × 220 × 2,200	–0.025	0.000	0.030	,, B c
7	5.54	190 × 220 × 2,200	0.029	0.054	–0.015	,, D a
8	5.54	390 × 420 × 2,200	0.077	0.020	–0.061	,, D a
9	5.54	390 × 720 × 2,200	0.029	0.025	0.000	,, D a
10	4.66	190 × 220 × 2,200	0.019	0.081	–0.030	,, D b
11	4.66	390 × 420 × 2,200	0.024	0.028	–0.030	,, D b
12	4.66	390 × 720 × 2,200	0.108	0.020	0.024	,, D b

* For Bibliography see first part of Paper, FOUNDRY TRADE JOURNAL, July 9, p. 21.

* This is only the author's personal view. But even if a greater accuracy is assumed, the remarks which follow still apply.

* The early investigations of Sulzer Broth., Winterthur ("C. Jüngst, Stahl u. Eisen," 29 (1909), pp. 1177–82), gave the same results.

mented by researches carried out by the Piwowarsky school, which were directed at establishing the influence of alloy additions on the sectional sensitivity of castings. *E. Hugo, E. Piwowarsky and H. Nipper*[50 52] employed for their investigations box-shaped castings with an outside diameter of 300 by 300 by 450 mm. and a wall thickness of 20 mm., 40 mm., 60 mm. and 80 mm. The iron was taken from the cupola and the alloys were added in the ladle. They

TABLE VI.—*Wall-thickness Exponents from Experimental Work of E. Hugo, E. Piwowarsky and H. Nipper.*[52]

Melt No.	C.	Si.	Mn.	P.	S.	Ni.	Cr.	Mo.	W.	Cu.	—a.	—b.	—c.
1	3.35	1.20	0.67	0.20	0.135	—	—	—	—	—	0.093	0.109	0.050
2	3.20	2.16	0.50	0.25	0.100	—	—	—	—	—	0.156	0.188	0.111
3	3.02	3.43	0.62	0.26	0.100	—	—	—	—	—	0.355	0.353	0.153
4	3.29	2.16	0.63	0.42	0.135	—	—	—	—	—	0.093	0.198	0.048
5	3.28	2.07	0.60	0.73	0.110	—	—	—	—	—	0.175	0.295	0.063
6	3.26	1.97	0.57	1.04	0.110	—	—	—	—	—	0.242	0.271	0.080
7	3.26	2.11	0.60	0.20	0.115	1.03	—	—	—	—	0.075	0.080	0.070
8	3.24	2.02	0.60	0.20	0.115	2.30	—	—	—	—	0.072	0.058	0.035
9	3.26	1.93	0.60	0.22	0.115	3.22	—	—	—	—	0.055	0.030	0.025
10	3.26	1.64	0.60	0.23	0.13	2.17	—	—	—	—	0.088	0.080	0.050
11	3.35	1.08	0.57	0.20	0.14	3.02	—	—	—	—	0.055	0.038	0.013
12	3.33	1.60	0.63	0.41	0.13	2.09	—	—	—	—	0.135	0.090	0.043
13	3.33	1.60	0.63	0.77	0.13	2.11	—	—	—	—	0.156	0.202	0.038
14	3.33	1.55	0.57	0.98	0.13	2.01	—	—	—	—	0.258	0.236	0.085
14B ..	3.28	1.55	0.59	1.02	0.11	1.95	—	—	—	—	0.315	0.173	0.098
15	3.22	2.20	0.54	0.21	0.18	—	0.29	—	—	—	0.093	0.083	0.050
16	3.22	2.77	0.57	0.21	0.14	—	0.67	—	—	—	0.163	0.180	0.075
17	3.27	3.29	0.60	0.21	0.14	—	1.13	—	—	—	0.182	0.301	0.100
18	3.27	2.15	0.63	0.23	0.14	1.36	0.69	—	—	—	0.115	0.129	0.030
19	3.25	1.65	0.59	0.20	0.12	2.20	0.71	—	—	—	0.070	0.088	0.038
20	3.33	1.32	0.59	0.21	0.12	3.14	0.78	—	—	—	0.043	0.033	0.015
21	3.35	2.25	0.60	0.21	0.13	—	—	0.21	—	—	0.100	0.143	0.055
22	3.35	2.20	0.60	0.20	0.13	—	—	0.47	—	—	0.075	0.136	0.058
23	3.33	2.25	0.60	0.20	0.12	—	—	1.04	—	—	0.038	0.088	0.030
24	3.36	2.25	0.60	0.22	0.11	—	—	—	0.10	—	0.100	0.151	0.075
25	3.34	2.20	0.63	0.22	0.10	—	—	—	0.54	—	0.063	0.083	0.038
26	3.30	2.20	0.60	0.23	0.10	—	—	—	1.49	—	0.118	0.119	0.045
26B ..	3.26	2.06	0.60	0.21	0.13	—	—	—	2.22	—	0.125	0.129	0.055
27	3.28	2.16	0.61	0.20	0.13	—	—	—	—	0.72	0.075	0.111	0.033
28	3.26	2.11	0.60	0.20	0.13	—	—	—	—	1.91	0.088	0.106	0.040
29	3.26	2.11	0.61	0.20	0.13	—	—	—	—	2.80	0.053	0.070	0.040

examined the influence of silicon, phosphorus, nickel, chromium, molybdenum, tungsten and copper. On account of the wide range of this work it is obvious that of a total of 31 melts only two or three heats were available to indicate the influence of each separate element; we are thus again dealing with introductory tests only. The authors themselves already calculated the sectional exponents and correlated these in a diagram. With such accuracy as is determined by the small scale employed the writer has grouped in Table VI those exponents of principal interest. If these values are only roughly

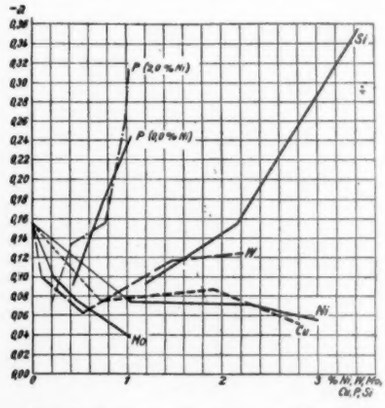


FIG. 13.—INFLUENCE OF VARIOUS ELEMENTS ON THE SECTIONAL SENSITIVITY, ACCORDING TO HUGO, PIWOWARSKY AND NIPPER.

compared with those found for test bars (Tables I, II and IV), a first glance shows that the numerical values of *a*, *b* and *c* are much smaller, thus bringing out the influence of the test objects. If, in order to make a general survey of the numerical values available, the relationship between *a* and *b* and also *a* and *c* are plotted graphically (Figs. 11 and 12), it is seen that, contrary to *Heller and Jungbluth*,[49] with *Hugo, Piwowarsky and Nipper*,[52] the transverse strength (Fig. 11) appears to differ more than the tensile strength. This is a remarkable fact for which the present writer cannot offer a satisfactory explanation. Nevertheless, it must be borne in mind that Hugo and his collaborators in their bending tests used machined bars, while the writer and his collaborator employed "as-cast" ones. The trend of the relationship between *a* and *c* (Fig. 12) found by Hugo, Piwowarsky and Nipper is the same as that deduced by Heller and Jungbluth, except that the latter's curve is higher, while they also dealt with materials having higher values.

Fig. 13 shows the relationship between the alloy elements and *a* values, and confirms the long-known result that silicon and especially phosphorus raise the sectional sensitivity considerably (phosphorus even in the presence of 2 per cent. Ni), and that molybdenum and nickel lower it, while copper has the same effect up to 1 per cent., but beyond this has only a slight influence. The effect of tungsten is doubtful. It is worth while to study in more detail the effect of nickel. To do this the writer has drawn Fig. 14, in which the effect of nickel for three different silicon contents is represented. The values for zero nickel and the requisite silicon content are obtained by interpolation from the silicon curve in Fig. 13. It is seen that at a high silicon content, viz., at about 2 per cent., the addition of about 1 per cent. nickel considerably lowers the sectional sensitivity, but that a further increase in nickel has no marked additional influence. (The absolute strength did not in fact increase.) At 1.65 per cent. Si the decrease in sectional sensitivity by adding more than 2 per cent. nickel was only moderate, and at 1.12 per cent. Si practically negligible (only the absolute strength with a wall thickness of, *e.g.*, 20 mm. increased from about 13.9 tons per sq. in. (22 kg. per sq. mm.) to 16.8 tons per sq. in. (26.5 kg. per sq. mm.). The effect of the chromium at different silicon contents is shown in Fig. 15, which the writer has also based on the data of Hugo and his collaborators. According to these investigations this effect—in each case between 2 and 3 per cent. Si and 0.3 to 1.2 per cent. Cr—causes a diminution of the sectional factor, which is apparent *a priori*.

At the end of this section reference may be made to the sectional sensitivity of castings included in a normal day's output. The writer was able to study specimens of different wall thickness from some discarded castings made by Fried. Krupp A.-G., Essen. The German standard test bar of 30 mm. diameter and 650 to 700 mm. long had also been separately cast and tested. In Table VII the most important data are collated,

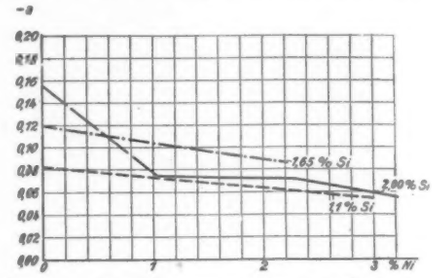


FIG. 14.—INFLUENCE OF NICKEL AND SILICON ON THE SECTIONAL SENSITIVITY, ACCORDING TO HUGO, PIWOWARSKY AND NIPPER.

and Fig. 16 shows graphically the strength values for different wall thicknesses. Nos. 1, 3 and 4 were obtained from locomotive cylinders, weighing about 2,977 lbs. or 1,350 kg., Nos. 2 and 6 from steam storage tanks weighing about 331 lbs. or 150 kg., and No. 5 from a wheel body. A definite relationship between the various values is not immediately apparent. All that can be deduced is that, except for No. 6, the sectional sensitivity is on the whole small.*

III.—Relations between Strength Characteristics of Wall-Thickness Specimens and of Test Bars

The question of the relationship between the strength properties of wall-thickness specimens and of separately-cast or attached test bars is just as important to the foundryman as a knowledge of the sectional sensitivity *per se*. It is so closely connected with this latter characteristic that at least a brief discussion is necessary at this place.

Here, too, only few systematic investigations have been carried out. Firstly, J. W. Bolton's[23]

TABLE VII.—*Sectional Sensitivity of Castings in Normal Production.*

No.	Type of Casting.	Composition.						— a.
		C.	Si.	C+Si.	Mn.	P.	S.	
1	Steam cylinder	3.20	1.07	4.27	0.57	0.16	0.06	0.140
2	Steam chest	3.31	1.19	4.50	0.83	0.20	0.10	0.081
3	Steam cylinder	3.31	1.42	4.73	1.13	0.13	0.08	0.070
4	Steam cylinder	3.40	1.60	5.00	0.63	0.19	0.10	0.095
5	Wheel body	2.74	1.63	4.37	0.42	0.19	0.10	0.170
6	Steam chest	3.36	1.43	4.79	0.95	0.21	0.09	0.189

proposals must be recalled, that the test bars must have the same ratio of volume to surface as the castings themselves. Furthermore M. v. Schwarz and A. Väth[46] on the basis of their experiments concluded that separately-cast test bars with a diameter double the wall thickness of platelike castings have roughly the same strength properties as the castings themselves. This would indicate, as simple mathematical con-

* The very interesting and perhaps also important fact may be mentioned, that the difference between the strength of the separately-cast test bar of 30 mm. diameter and the strength of the same wall thickness to be interpolated is clearly related to the C + Si content, a fact which is obvious *a priori* and of potential practical value.

siderations show, that for one and the same iron the sectional sensitivities of a casting and of the corresponding test bars would be the same, a fact not supported by the experimental data of other investigators. v. Schwarz and Väth also point out in their Paper that for castings of more complicated shapes other laws would be valid than those which they had found in regard to castings of simple shape.

It is perhaps possible to deduce a general law from the observations made by the writer on the

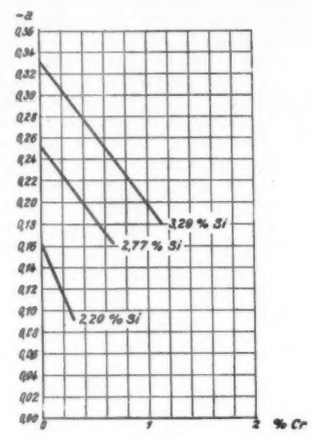


FIG. 15.—INFLUENCE OF CHROMIUM AND SILICON ON THE SECTIONAL SENSITIVITY.

above-mentioned discarded castings from Krupp's production, namely that the difference between the strengths of the test bar of 30 mm. diameter and of a wall thickness of 30 mm. becomes steadily smaller with improvement in the quality of the cast iron. This difference is practically zero for high-duty cast iron, and as this material has also only a small sectional sensitivity the 30 mm. test bar already very closely represents, in the opinion of the author, the strength of the casting itself.

It is due to Dübi[49 51] to have introduced an entirely new aspect of the relationship between wall thickness and test bar values, by his proposal of the "hardness characteristic." His suggestion may be formulated as follows: It is definitely not possible to establish fundamental relationships between the different mechanical values of cast iron. But for specific cast irons of similar class, relationships of this type can be found with a satisfactory accuracy to apply

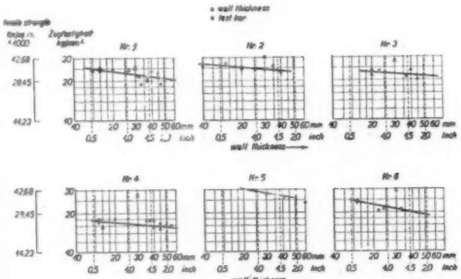


FIG. 16.—SECTIONAL SENSITIVITY OF CASTINGS IN NORMAL PRODUCTION.

to such specific groups, which he deduces from some of his earlier work.* He therefore proposes to cast with the castings to be tested two separate test bars of 30 mm. and 50 mm. diameter respectively, of which the tensile strength and Brinell hardness are determined. He then plots the tensile strength of the bars as a function of the Brinell hardness, and thus obtains in his diagram two points which are joined by a straight line called the "hardness characteristic" ("Härtecharakteristik"). If the casting is now tested for Brinell hardness, the hardness characteristic will give the tensile strength corresponding thereto. In Fig. 17 the hardness characteristics are given as drawn from the average value. E. Dübi [51] suggests that the hardness characteristic $H=f(\beta z)$ for a specific cast iron is a suitable source of information of the effect of the wall thickness or the sectional sensitivity. The writer does not entirely subscribe to this assumption. However, a theoretical basis seems to be provided, and it is now necessary to collect more experimental data. The above-mentioned investigations of the Cast-Iron Committee of the Verein deutscher Eisenhüttenleute are including consideration of this matter.

IV.—Sectional Sensitivity of Other Metals

In conclusion it is of interest to consider in what range of values the sectional sensitivity of other alloys may lie, as this alone will show whether cast iron in this respect suffers from a special disability or not. This is definitely the case if an iron casting is compared with steel castings. The writer has analysed data published by A. Rys* on alloyed and plain steel castings. Up to a wall thickness of 120 mm. no sectional effect can be found in the vast majority of cases considered. Even between wall thicknesses of 40 to 400 mm. the a values lie within the range of only 0.03 to 0.07, these values being in fact derived not from castings but from test bars, which certainly show a greater variability than the castings. Black-heart malleable iron, too, gives better results. H. Jungbluth and F. Brügger† determined the tensile strength of American malleable iron on specimens of different

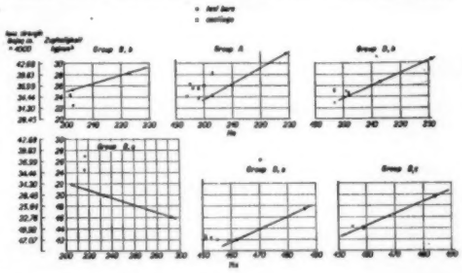


FIG. 17.—HARDNESS CHARACTERISTICS OF TEST CASTINGS (DÜBI).

diameters. If these values are plotted logarithmically a straight line is obtained with a gradient of −0.18, representing a small value for test bars. On the other hand, the sectional sensitivity of aluminium alloys is of the same order of magnitude as that of cast iron. *H. v. Schwarz*‡ gives a series of strength values for aluminium alloys, from which *H. Jungbluth and P. A. Heller*§ selected a "self-improving" German aluminium alloy and compared it with a cast iron of the German standard Ge 14.91, with a tensile strength of about 8.8 tons per sq. in. (14 kg. per sq. mm.). At the time they already came to the conclusion that the sectional sensitivity of the two alloys did not differ very much. If they are expressed by a values, the cast iron in question had a value of − 0.63 and the aluminium a value of − 0.69. These values are in good agreement with those recently found by *E. Söhnchen*‖ on temperable aluminium alloys and which ranged between − 0.13 and − 0.75.

The material "cast iron" in regard to its sectional sensitivity does not occupy an exceptional position. It shares this property with other cast alloys, while its numerical value is also of the same order of magnitude.

Conclusions

Summarising the above the following conclusions may be drawn:—

(1) The problem as regards the general law of sectional sensitivity of plain cast iron test bars can be assumed to be solved. Numerical relationship between the C + Si and the sectional exponent a, b or c can be stated, which are as close as can be expected only in the case of statistical relationships.

(2) Investigations have also been conducted on the influence of alloy elements on the sectional sensitivity of test bars, which must be regarded as tentative experiments. They present a qualitatively consistent picture, but for quantitative evaluation the number of experiments made is not yet large enough.

(3) The data on the sectional sensitivity of castings are still more meagre. It is for the present by no means sufficient to give a clear conception of the numerical relationships. Especially in this direction a wide field is still open for research.

(4) Concerning the influence of alloy elements on the sectional sensitivity of castings the data available are as voluminous as those for test bars. Here also only qualitative and not quantitative conclusions can be drawn.

(5) The relationship between the mechanical properties of the wall thickness in castings and in test bars is likewise still obscure. At most it can be said that for high-duty cast iron the mechanical properties of the test-bar coincide up to a point with those of the casting. Systematic investigations are also urgently required in this direction, and in Germany at least are now being carried out.

(6) The sectional sensitivity of cast iron is not peculiar to this material alone. It shares it with other cast alloys, cast iron being thus comparable to aluminium, while black-heart malleable iron has a lower and cast steel no sectional sensitivity.

* Report of discussion No. 37 of the Swiss Institution for Testing Materials at the E.T.H., Zürich, Dec., 1928, pp. 7–18.

* "Kruppsche Monatshefte," **11** (1930), pp. 47–76. Cf. Stahl u Eisen, **50** (1930), pp. 423–38.
† "Schriften des Reichskuratorium für Technik in der Landwirtschaft," Berlin, S.W.11, No. 56 (1934).
‡ "Zeitschrift für Metallkunde," **25** (1933), pp. 269–71.
§ "Stahl u. Eisen," **54** (1934), p. 1092.
‖ "Giesserei," **23** (1935), pp. 100–106.

Hot-Face Insulation

A Paper by H. V. ALLEN read before a recent meeting of the Ceramic Society described a new development in the production of firebrick insulation. The type of insulation brick made from diatomite has always had certain limitations in its use. Beyond a limiting temperature of 800 to 900 deg. C. its insulating properties break down, because the brick has a low sintering point. Accordingly the use of diatomite has been confined to the lagging of an existing firebrick wall. The bricks described combine a refractoriness equivalent to that of a high-grade firebrick with an insulating property equivalent to that of a diatomaceous brick. Accordingly a marked advantage of such a material is its use as the inside lining of a furnace or kiln. Data were given in the Paper to show the savings possible in heat storage as well as in external heat losses.

A considerable amount of information is given relating to the performance in practice of furnaces and kilns constructed in the manner outlined. In kilns for burning firebricks it has been possible to achieve a fuel saving of 30 per cent., and a saving of time in the cycle of burning of some 20 hours, of which the greater part of the saving is ascribed to the use of hot-face insulation and its method of application. Similar results have been obtained in the firing of building bricks, roofing tiles, pottery ware, and in certain types of metallurgical furnaces. The production of hot-face insulation introduces a new technique into the construction of all classes of furnaces and kilns, and a considerable field for fuel economy is envisaged.

Portable Centrifugal Oil Purifiers

(BY OUR ENGINEERING CORRESPONDENT.)

The extensive new film studios at Denham, near Uxbridge (Middlesex), belonging to London Film Productions, Limited, have not only seven sets or stages and all accessories of the most complete character, but also their own independent power plant for the electric lighting, machine shops, workshops, and even a foundry. In the latter connection there is included a

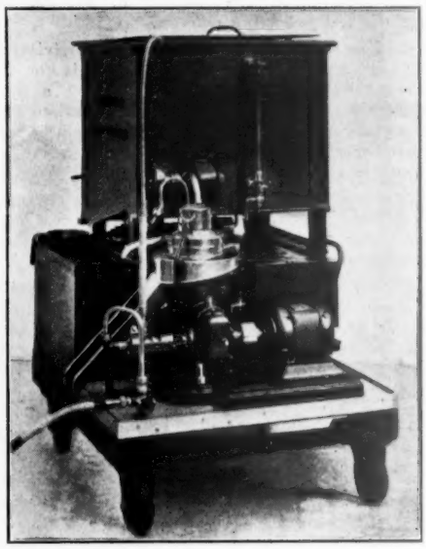


FIG. 1.—"HOPKINSON" DESIGN OF PORTABLE CENTRIFUGAL OIL PURIFIER WITH 25-GALL. TANK.

"No. 1 Portable" oil purifier, constructed according to the latest designs, by Hopkinsons, Limited, of Huddersfield, and having a 25-gallon oil tank. These purifiers, available both in the portable and permanently erected form, are of great interest for the iron and steel, foundry, and general engineering industries, as well as power stations, and are being used for the treatment of every description of oil, including lubricating oil, engine oil, fuel oil, switch oil, and Diesel oil.

The ordinary centrifuge consists, it will be remembered, of a bowl or drum revolving at a very high speed so that the impurities are thrown to the outside by the centrifugal force, while the main bulk of the oil in the clean condition remains at the centre and is discharged. In the "Hopkinson" designs of purifier, however, great improvements have been effected, including the use of an unperforated extended skirt, positive washing action by means of a stream of water, with two separate outlets for clean oil and dirty water, both of which are discharged continuously, and direct positive gear drive from an integral, totally-enclosed, drip-proof electric motor, with elimination of troublesome belts.

Essentially the machine consists of a bowl containing a pack of inverted thin metal separation cones or inserts, which are fixed close together, one above the other, on a central tube with a conical base, forming the unperforated skirt, attached to a vertical shaft running in ball-bearings. At the lower end this shaft is geared to another short vertical shaft, directly geared in turn to the electric motor, so that the centrifugal separator bowl with the pack of cone inserts is driven at a speed of 7,000 to 10,000 r.p.m., according to the size of the purifier.

The dirty oil along with the washing water enters at the top, passing down a central inlet pipe and flowing, while subjected, of course, to a powerful centrifugal force, under the unperforated skirt and up between the conical inserts. The heavier water and sludge is at the same time forced to the outside and discharges by an outlet at the top of the stationary outer casing, while the clean oil remains at the centre and flows out by another opening higher up, by way of a concentric space round the outside of the inlet pipe. The unperforated skirt is always in a water seal, and this positive water washing, also in the zone of maximum centrifugal force, is of great importance, removing the finest particles and water soluble organic acids.

The use of a direct gear drive, also totally enclosed in oil, is a great improvement on a non-positive belt, which is always liable to slip and cause a variation in the speed. Other features of the design are helical gears; centrifugal clutch to lessen the strain of the motor whilst starting; lubrication by oil mist; specially selected ball-bearings for both the thrust and radial loads; an electrical heater device (when necessary), and a counter to ensure the correct speed always obtains. Wear and tear and maintenance costs are described as negligible.

The machine is available in standard sizes, and within a range of, say, 40 to 800 gallons of oil per hr. capacity, the motors are 0.25 to 2.50 h.p., the power required being very small. The portable machines are carried on a substantial wheeled-truck base, and the tanks, which include an electrical heater tank for the dirty oil, are covered with a hinged lid. Flexible hose and electrical cable connections are used as required.

Sieray-Dual Lamps in a Coventry Works

The lighting of painting and enamel shops to enable work to proceed by artificial light has, in the past, presented a difficult problem to works engineers. After a good deal of experiment with lighting for this purpose, Alfred Herbert, Limited, of Coventry, solved the problem by lighting the painting shop depicted in the upper picture of Fig. 1 by means of Siemens Sieray-Dual Electric discharge lamps. The bay shown

FIG. 1.—SHOPS IN ALFRED HERBERT'S WORKS AT COVENTRY ILLUMINATED BY SIERAY-DUAL LAMPS.

has a floor area of approximately 8,000 sq. ft., and is lighted by nine 500-watt lamps of this type. These lamps have been installed in other parts of Messrs. Alfred Herbert's works, and the lower picture shows the appearance of one of the demonstration bays so lighted.

Properties of Open-Hearth Chequer Bricks

At a meeting of the Ceramic Society, held recently in London, DR. T. SWINDEN and DR. J. H. CHESTERS read a Paper on "The Properties of Open-Hearth Chequer Bricks." The following is a summary.

The authors describe certain preliminary laboratory experiments—made in the Central Research Department of the United Steel Companies, Limited—to determine which materials are most suitable for use in the chequers of open-hearth steel-melting furnaces. The results obtained from their tests for thermal and other properties show that there is very little to choose between the semi-silica and fireclay bricks examined, either as regards heat capacity or the rate at which heat is absorbed. Though the melting-points of the bricks were not very high, there seemed to be no likelihood of fusion occurring at normal chequer temperatures. The cold crushing strength also seemed adequate.

The high temperatures and bad slagging conditions existing at the top of the chequers necessitates the use of silica bricks or of highly-aluminous fireclay bricks. In some plants silica bricks are used almost exclusively in building the chequers. Results given in a table show that the general use of such bricks would probably have the effect of reducing the heat capacity, but that higher diffusivity would tend to compensate for this reduction.

A considerable number of the used bricks, though changed in colours, are unglazed, and can readily be freed from dust. Samples of fireclay bricks were taken from both the gas and air chequer chambers of a basic open-hearth furnace at the end of a normal run to ascertain whether such bricks were suitable for use in a second campaign. The bricks from the air chamber looked like new bricks, except that the outside layers seemed somewhat vitrified. The gas bricks showed when fractured a grey vitreous looking skin on a dark red interior. As regards chemical composition, the only marked change was an increase in the alkali content of the skin obtained from the gas chequer brick. The red colour implies merely a different state of oxidation of the iron—an altered brick reheated in an oxidising atmosphere assumes the original buff colour.

Melting-point, cold crushing strength and permeability, specific heat and thermal conductivity, heat capacity and diffusivity, were investigated, and finally a works trial was made of clean unglazed chequer bricks (from gas and air chambers) replaced in the chequers.

The authors' conclusions are:—(1) A strong similarity is found in such of the physical properties of fireclay and semi-silica bricks tested as would affect their use in open-hearth furnace chequers.

(2) Used chequer bricks, provided they are unglazed and can readily be freed from dust, can be re-used without any loss in efficiency.

(3) The principal materials responsible for the corrosion of steel furnace chequer bricks are iron oxide (45 per cent.) and lime (10 per cent.); although other materials, notably the zinc oxide and the alkalies, may be present in considerable amounts.

(4) A large amount of data is available as to the heating surface, etc., of various types of setting, but there does not appear to be any practicable method of comparing the thermal efficiencies of such special settings with the efficiency of those made from standard squares.

GENERAL REFRACTORIES, LIMITED, of Sheffield, report that the company's turnover for the month of June, 1936, constituted a record, being nearly 10 per cent. in advance of any previous figure achieved.

Do you get tests like THESE ?

TALBOT-STEAD TUBE CO., LTD., BIRCHILLS, WALSALL. May 27th, 1935.

REPORT ON SPECIMENS TESTED

Tests of Malleable Cast Iron for Messrs. A. H. Mould.

Marks on Specimens	Dimensions of Specimens in inches			Tensile Strain in Tons—Ultimate		Elongation in 2 ins. Per Cent.	Contraction		
	Outside Diam.	Inside Diam.	Area	Total	Per Sq. Inch		Diam.	Area	Per Cent.
W. W.	.585	—	.268	5.83	21.75	23.0	—	—	—
S.A.W.	.585	—	.268	5.68	21.20	20.0	.51	.204	24.0

Tested in the Presence of.....

Test House Manager.....

The tests obtained by Messrs. A. H. Mould & Sons, Ltd., on crucible melted malleable castings—elongation 23% with tensile strength 21 tons per sq. inch, shown on the test certificate reproduced above, are evidence of the extremely high properties characteristic of "UCO" All-Mine Pig Irons.

"UCO" irons are produced from molten blast-furnace iron, and are not "synthetic" or "refined" irons; they contain no remelted scrap, pig or admixed steel.

Obtainable in "MW" grades, for malleable castings, or "W" grades for cylinder and similar work in the form of machine cast slabs.

THE UNITED STEEL COMPANIES LTD

"UCO" ALL-MINE PIG IRONS

"MW" GRADES FOR MALLEABLE CASTINGS

WORKINGTON IRON & STEEL COMPANY

Branch of The United Steel Companies Limited

WORKINGTON CUMBERLAND

W.29

Foundry Selling Practice

HOSTILITY FROM WITHIN

By ERIC N. SIMONS

It is not rare in the history of British foundries to find that a good product, systematically distributed, with adequate sales management backed up by thorough and sensible advertising and marketing, is nevertheless slow in making its way, or even fails to make progress at all. When, in his despair, the founder analyses the reasons for this, he often finds that the cause is not, as might be expected, some unsuspected flaw in the product or the selling plan, but a certain hostility from within. This hostility is of various types. It may be in the production staff, owing to some grievance, or in the office staff for similar reasons. In selling, as a rule, this hostility will most often be found in the salesmen.

The writer of these notes is no theorist; he meets salesmen every day, and has first-hand experience of their reaction to the selling plans of their firms. He has found that before ever a sales plan can be fully successful, it has to be "sold" to the salesmen who put it into operation. In no direction has this winning over of representatives to be more efficiently carried out than in respect of advertising. Too often, the foundry takes it for granted that its salesmen believe in the value of the advertising done. Only when pertinent inquiries are made is it discovered that among certain members of the sales force quite a serious prejudice against advertising, and even against publicity as a whole, may exist.

The fact is, and let none dispute it, that many salesmen are *not* believers in the printed word as applied to selling. They may even be fiercely and actively hostile to it. Perhaps it will help towards the solution of this problem if the reasons for this prejudice are enumerated.

Reasons for Antagonism

First of all, whether they be correct in thinking so or not, many representatives do form the conclusion that all selling by other methods than personal call is designed ultimately to do away with the "man on the road," or at all events to minimise his importance and utility. Next, the salesman very often finds out, or if he does not succeed in finding out, enormously exaggerates, the money the foundry spends on printed publicity and advertising. Having ascertained or guessed at the sum, he begrudges it, believing that if this money were saved, not only would it be possible to sell the castings for less, thus facilitating the obtaining of orders, but his own commission would be larger.

Thirdly, he quite sincerely and frankly refuses to believe that the type of men from whom he obtains orders can be influenced by or even read advertisements, circular letters, and the like. Again, he may have some personal antagonism towards the publicity man, and for this reason delight in blocking or belittling his endeavours.

Next, the salesman frequently does not bother to read the foundry's advertisements and circulars, so that he cannot substantiate the claims made in them if challenged, and may even, in some instances, not even know enough of current developments to understand them. Lastly, there is often a dislike of advertising and publicity among the older type of representative because, if it has been carried out on modern and sensible lines, it becomes less easy for him to bluff through to an order. Buyers are educated by advertising, and many an old-time salesman has lost an order through inability to reply to the arguments of a competitor's advertisement when put to him by a purchaser.

These six points do, pretty fairly, sum up the salesman's potential reasons for hostility towards the marketing campaign. Of course, even if this hostility be detected, it is scarcely wise to get rid of the men who harbour it. Far better and kinder it is to try to rid them of their prejudices. This can only be accomplished by persuasion. It may, therefore, be advisable to consider these six causes of hostility and indicate how they might be removed.

Causes Analysed

So far as the first cause, a belief that advertising is intended to supplant or belittle the salesman, is concerned, nothing is better than a flat denial of the assumption. The sales manager, however, must not fail to make the point that advertising is forced, sooner or later, to change the requirements of a salesman. This must be expounded.

No amount of publicity can dispense with the need for the personal touch. One might as well try to fly a kite without string as sell castings without salesmen. But whereas, a hundred years ago, it may not have been essential for the representative to have foundry experience of a practical kind, so long as he had some sales talk at his command, to-day advertising does all that preliminary work of "making the foundry known." The salesman whose foundry has systematised its marketing methods on modern lines has taken away in the majority of instances the opening fire of the old-time salesman. If he starts to tell the buyer whom he works for, who they are, where their works are situated, and what they make, he is wasting valuable time telling him what the advertising and circularising have told him already.

The modern salesman's job is to dispense with this introductory matter wherever it is inessential, and go straight into his sales talk proper. This means that modern salesmanship demands of the salesman a more scientific and specialised approach. If the foundry advertises and sells intensively, the salesman should utilise the personal call for exposition and not for introduction. He will, therefore, need to know more about the castings. Salesmen who are unwilling to spend some time and energy on mastering the castings they have to sell may, in very truth, find that advertising tends to eliminate them; but this only means that it eliminates the man who is neither willing to learn nor possessed of any constructive ability in the direction of marketing.

The salesman who is hostile to advertising because he imagines it is designed to replace him is either uninstructed—which can easily be remedied—or unteachable, in which case he has only himself to blame if modern foundries turn to modern salesmen. The uninstructed salesman can be persuaded of the advantages of publicity and advertising in quiet and friendly conversations, backed up by as much evidence as possible of the way in which advertising has facilitated sales for other representatives of the foundry. The salesman can be led to see for himself that it is an integral feature of modern foundry marketing. It has its specific functions, and no more competes or conflicts with himself than the hammer head does with the hammer handle.

Overcoming Prejudice

The old-time salesman frequently demands or requires some assurance before he will abandon his hostility. He knows he is getting on in years. He suspects he may be conservative. Yet he cannot remove either defect. The struggle for existence being so severe, he hesitates to support whatever seems to menace his position. The foundry must recognise this, and make him feel secure. Only the forthright declaration by an honourable employer that advertising and kindred practices are not designed as the thin end of a wedge that will ultimately force him out of his job will satisfy him. That declaration made, however, he will probably come round, and may even develop a belated enthusiasm for the printed word. This is a form of gratitude for his security.

The salesman who regards marketing expenditure of the type under discussion as a large amount of cash stolen from his salary can only be tackled by giving him facts and figures that his materialistic nature will not let him dodge. He should be told the exact relation between advertising expenditure and selling costs, between advertising and turnover. These details may convert and must inevitably surprise him. Very seldom does this type of representative understand how prices and commissions are ascertained. It would be an advantage if he could be induced to spend a day or so in the estimating office, to find out for himself to how small an extent advertising affects his commission account.

Sales Analyses as Evidence

The salesman who disbelieves that buyers read or are influenced by advertisements may be overcome if the foundry is able to check the results of its expenditure. A morning's post with the requests for catalogues or leaflets from important buyers, the trial orders, the inquiries, the replies, obtained by advertisements can be shown him. He can see the list of new accounts created by the combination of publicity and salesmanship. He can hear what the more enlightened representatives have to say of the marketing plans, and the value they attach to publicity. If he can be persuaded to inquire of buyers in his own district, he will inevitably discover that they have formed many of their opinions as to his employers and their castings from advertisements and circulars.

How Trouble Arises

The question of personal enmity between advertising manager and a particular salesman is a delicate one. This is what often happens in such instances. A buyer mentions to the salesman a claim in a particular advertisement. The salesman replied: "Oh! don't take any notice of that. I know the man who writes these adverts. He's a . . . (whatever epithet seems most appropriate). If you want the real facts about our castings, I'll tell you all you need know."

"But surely your firm's advertisements are checked by someone before they appear?"

"I should doubt it."

Thus, instead of salesman and advertising combining, the former does all he can to neutralise the latter. The buyers in that territory disbelieve the advertising, or the salesman—both bad results. On the other hand, the salesman may complain to the foundry that the kind of advertising the advertising manager is putting out is just what is wrong for his district; that buyers laugh at it; that it is doing the firm more harm than good, etc. Where these complaints are due to personal antagonism, the foundry is placed in a difficult position. If the two cannot be reconciled, the only possible way out is to invite the resignation of one or other, whichever seems at fault. This often brings the offender to his senses. Patience and tact may remove this antagonism. In any event, the foundry must make it clear to the representative that he is injuring his own interests, and seriously affecting the firm's prestige. Only too often the offender fails to perceive that in attacking or ridiculing the advertising, he is attacking his firm's reputation. This conduct puts his action into the list of serious offences. It is more than mere spite; it is most damaging.

Salesmen who do not study the foundry's advertising miss out an important link in the marketing policy. There is, however, some blame attaching to the sales manager for this. Before

(*Concluded on page* 52.)

CUMMING'S BLACKINGS
ARE
THE BEST

Extract from daily report by one of our travellers:—

January 9th, 1936.

Mr. C..... said,

"I shall send on to you every time. Since we adopted your Blacking the skin of our castings has improved by 100 per cent. Our customers were the first to notice it."

NEED WE SAY MORE

All our productions are carefully graded, tested and manufactured.

WM. CUMMING & CO., LTD.

KELVINVALE MILLS, Maryhill, Glasgow, N.W.
SUNNYSIDE BLACKING MILLS, Falkirk.
WHITTINGTON MILLS, Chesterfield.
DEEPFIELDS MILLS, Bilston.
STATION CHAMBERS, Middlesbrough.

The Week's News in Brief

Trade Talk

THE SOVIET STEAMER, "Kama," from Leningrad, unloaded 1,500 tons of pig-iron at Prince's Dock, Glasgow, last week.

MR. E. A. B. COXHEAD, 11, Wallwood Road, Leytonstone, Essex, metal founder, is paying a first and final dividend of 3½d. in the £.

IT HAS BEEN announced that control of the British Mannesmann Tube Company, Limited, has now passed into British hands. In consequence, it has been decided to change the name of the company to "The Newport & South Wales Tube Company, Limited." This change became effective on July 1. The majority of the former British directors are continuing on the board of the company.

THE BRIGHTSIDE FOUNDRY & ENGINEERING COMPANY, LIMITED, have made a 100-ton iron base-block, which will be machined at the Vickers works of the English Steel Corporation, Limited, Sheffield. When completed it will be used by B. & S. Massey, Limited, of Openshaw, for a 5-ton drop stamp which they are making.

A NEW STEELWORKS for the manufacture of cold-rolled steel strip is being erected at Rotherham. Orders for the mills and other plant have been placed, and production is expected to begin in October. About 30 skilled workmen will be employed. Mr. J. A. Uttley, of Kimberworth, is in control of the new business, the prime mover in which is Mr. B. Bennett, a well-known Rotherham iron and steel merchant.

A VISIT to Birmingham was arranged by the metallurgical department of the Sir John Cass Technical Institute, London, on July 8. In the morning the party of students was welcomed at the works of Henry Wiggin & Company, Limited, by Mr. H. A. Perring and Mr. J. A. Bailey, and was conducted through the works. In the afternoon the foundries of William Mills, Limited, were visited. Mr. Carrington welcomed the students, who were shown through the works and afterwards entertained to tea.

WILLIAM JACKS & COMPANY have undertaken the sales agency for Europe and the East of the Chromium Mining & Smelting Corporation, Limited, of Hamilton, Ontario, manufacturers of high-grade ferro-silicon (45 to 50, 75 per cent. and upwards), and also of ferro-chrome and silico-manganese. Canadian ferro-silicon has already been shipped to European ports, and the production is now on quite a large scale. Owing to cheaper water-power and favourable sources of ore, these works are able to compete successfully with Scandinavian producers.

THE COMMITTEE appointed by the Government to report on the advisability of establishing a gas grid for the West of Scotland met in Glasgow on July 9 and approved the preliminary reports of local authorities and industrial concerns who had been asked to state the prospects of increased consumption for industrial purposes. The committee will meet again in August to hear further evidence from representatives of the Iron and Steel Trades Confederation, the National Union of General Workers, and the National Union of Mine Workers.

Foundry Selling Practice

(*Concluded from page 50.*)

any big marketing scheme is launched, he should call the salesmen together and outline the plan. Their comments should be invited and considered. They should be given copies of each advertisement or circular proposed, and any doubts they have as to the accuracy of the claims made should be dissipated. Thus, one foundry recently advertised certain figures of life for its castings. The salesman, receiving a copy of the advertisement, returned it with the undermentioned remarks in red ink written across it: "This is rubbish! Who has been pulling your leg? Our castings couldn't do it." In answer, the official report, signed by a large user of these castings, was sent to him. But the salesman ought to have known of this report in advance of the advertisement.

The gas grid would provide an outlet for 17,500 cub. ft. of by-product gas per day to be produced by William Dixon, Limited, Glasgow, William Baird & Company, Limited, Coatbridge, and James Nimmo & Company, Limited, Glasgow.

INTERNATIONAL COMBUSTION, LIMITED (Grinding, Screening and Filtering Division), report that amongst recent orders received for England are pulverising equipment, including separators, fans, cyclones, piping and dust collectors for grinding poisonous materials and whey; three 4 ft. by 5 ft., and 4 ft. by 6 ft. and 4 ft. by 8 ft. Hum-mer screens for screening lead ore; Rotap testing sieve shakers for sieving tests; No. 3 hydrators and Raymond mechanical air separators for producing finished hydrate; and an Andrews de-slimer for separating lead ore and sand. Orders for abroad include 3 ft. by 8 in., 3 ft. by 18 in., 4 ft. 6 in. by 16 in. and 54 in. by 24 in. Hardinge mills for grinding copper and gold ores. Orders for Hum-mer electric screens include type 400's for screening dry copper ore.

METALECTRIC FURNACES, LIMITED, the recently formed company, whilst a new entrant in the electric furnace industry, has acquired world-wide rights and licences for both the manufacture and sale of an important series of basic furnace patents and processes which have attained universal recognition throughout the metallurgical industries. Its Smethwick works, which are modern and extensively equipped, incorporating iron and steel foundries, machine, erecting, steel-work, welding and sheet-metal shops, physical and chemical research laboratories, provides adequate facilities for the specialised and complete manufacture of all types of electric furnaces and equipment, together with Metalectric refractory heat-resisting metals. The firm's products embrace a complete range of types of furnaces and processes for the ferrous and non-ferrous industries, from small portable units, low-temperature re-circulating systems, to the largest mechanised fully-automatic continuous units with auxiliary equipment for bright annealing, atmosphere control and similar processes. Metalectric Furnaces, Limited, whose address is Cornwall Road, Smethwick, Birmingham, consolidate the combined skill of a group of well-known industrial furnace, electric and mechanical engineers and metallurgists of highly specialised experience in the design and application of electric furnaces to every phase of the metallurgical industries.

Contracts Open

Belfast, August 10. — Electrically-driven centrifugal pump to deliver 20,000 gallons per minute, with switchgear, piping, valves, etc., for the Town Council. The City Surveyor's Department, Drainage Section, Room 94, City Hall, Belfast.

Chippenham, July 23.—2,135 yds. of 6-in. dia. coated cast-iron pipes, for the Town Council. Mr. C. R. Phillips, borough surveyor and water engineer, High Street, Chippenham, Wilts. (Fee £2 2s., returnable.)

Dent, July 21.—1,800 yds. of 3-in. asbestos and spun-iron pipes and 500 yds. of 2-in. cast-iron pipes, for the Sedbergh Rural District Council. F. J. Rodwell & Son, engineers, Prudential Buildings, 20, Park Row, Leeds, 1. (Fee £1 1s., returnable.)

Donhead St. Mary, July 21.—Ten miles of 3-in. and 4-in. spun-iron pipes, for the Mere and Tisbury Rural District Council. Mr. A. J. Martin, 106, St. George's Square, Westminster, S.W.1. (Fee £3 3s., returnable.)

Leighton Buzzard, July 30.—48 tons of 6-in., 4-in. and 3-in. spun cast-iron pipes and specials (class C), for the Urban District Council. Sands & Walker, consulting engineers, Milton Chambers, Nottingham. (Fee £2 2s., returnable.)

Ramsey, July 29.—16 miles of cast-iron water main from 8-in. to 3-in. dia., for the Urban District Council. Pick, Everard, Keay & Gimson, consulting engineers, 6, Millstone Lane, Leicester. (Fee £2 2s., returnable.)

Ramsey, July 29.—Ten miles of 7-in. and 8-in. cast-iron piping, for the Ramsey Urban District Council and St. Ives Rural District Council. Pick, Everard, Keay & Gimson, consulting engineers, 6, Millstone Lane, Leicester. (Fee £2 2s., returnable.)

Personal

MR. PYATT, the Eastern Counties representative of General Refractories, Limited, has removed from Leicester to "Longcroft," Castle Road, Bedford. Mr. Greaves, the West Riding and North Lancashire representative, has removed from Pontefract to 6, The Grove, Hipperholme, near Halifax.

MR. JAMES PETRIE, finance secretary to Colvilles, Limited, received a presentation, on July 10, from the directors and staff, in recognition of his 14 years' services as secretary and treasurer of the firm's superannuation fund. Mr. J. B. Allan made the presentation, and Mr. John Craig presided.

LT.-COL. M. D. METHVEN, B.A., O.B.E., and MR. R. H. BLAKE, M.C., M.Inst.Eng.(Australia), etc., have been appointed general manager and chief engineer respectively of the North Eastern Trading Estate, which is the first of the non-profit-making trading estates to be set up under the powers granted to the Commissioner for the Special Areas.

THE COUNCIL of the Iron and Steel Institute announces that Mr. Alfred Hutchinson, M.A., B.Sc., Vice-President (director of the Skinningrove Iron Company, Limited), has been nominated President of the Iron and Steel Institute, to take office in May, 1937, on the retirement of the present President, Sir Harold Carpenter, F.R.S., and that the Right Hon. the Earl of Dudley, M.C., Member of Council (chairman of the Earl of Dudley's Round Oak Works, Limited), has been nominated President, to take office in May, 1938.

Obituary

MR. HARRY HUME SANDERSON, managing director of Hattersley Bros., Limited, Queen's Foundry, Swinton, Yorks, died recently at his home in Rotherham.

MR. FRANK BURRELL, senior director of Shipham & Company, Limited, brassfounders, and George Clark & Sons, Limited, Hull, whose death occurred recently, went to Shipham & Company as a boy, and at 18 he was manager. He built up the establishment from one employing 12 men to its present position of one of the largest brassfounders in the North, with 300 employees.

Company Reports

Davy Bros., Limited.—Net profit, after providing for depreciation, £22,706; dividend of 5 per cent., £14,537; directors' additional remuneration, £1,135; carried forward, £7,034. Meeting, July 20.

Potters, Limited.—Net profit, £13,641; brought in, £17,461; transferred from reserve fund, £40,000; preference dividend for 2½ years ended September 30, 1935, £29,062; bonus of 2s. per share on ordinary shares, free of tax, £11,250; interest on funding certificates, £1,062; dividend on the preference shares for the half-year ended March 31, 1936, £5,719; to funding certificate redemption fund, £3,000; dividend on the ordinary shares of 7½ per cent. for the year ended March 31, 1936, £6,434; carried forward, £14,575.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Newall Engineering Company, Limited.—Capital, £130,000. Machine tool and gauge manufacturers. Directors: S. Player, Cardyke House, Paston, Lincs; K. E. Summers and E. Bunting.

Birmid Industries, Limited, Birmid Works, Dartmouth Road, Smethwick, Staffs.—Capital, £750,000 in £1 shares. To acquire not less than 90 per cent. of the issued share capital of the Aluminium Casting (1903) Company, Limited, Midland Motor Cylinder Company, Limited, Sterling Metals, Limited, Pneulec, Limited, Dartmouth Auto Casting, Limited, and Birmabright, Limited, etc. Directors: C. C. Maudslay, Col. A. H. Browne, W. P. Lindsay, and P. Pritchard.

THE "ROCKET" CORE MAKING MACHINES

HELP to . . .

REDUCE COSTS AND MAKE SOUND CASTINGS

for

BRITISH

— STEEL FOUNDERS —
GREY IRON FOUNDERS
MALLEABLE FOUNDERS
NON-FERROUS FOUNDERS

used in the manufacture of—

Electric Cookers. Gas Cookers. Motor Transport Vehicles. Aeroplanes. Internal Combustion Engines. Cast Iron Bath Fittings. Brass Water Service Fittings. Sluice Valves. Gas Valves. Rain Water Castings. Textile Machinery. Lawn Mowers. Ship Building, etc., and General Engineering Castings.

FOUNDRY ENGINEERS LIMITED

HALIFAX — YORKS.

Telephone: Halifax 61459. Telegrams: "FEL," Halifax.

Raw Material Markets

All the iron and steelworks are active, and much of the prospective output to the end of the year has already been sold. Pig-iron continues to go away from the furnaces almost as made. Deliveries are in excess of the make and stocks at the furnaces, already much reduced, are steadily being drawn upon. At the present rate of consumption a shortage of iron will become apparent before very long. The steelworks are behind with specifications, but are meeting the requirements of consumers without undue delay.

Pig-Iron

MIDDLESBROUGH.—Demand for Cleveland pig-iron is undiminished. With production in greater volume, the makers are reducing arrears of deliveries, but are not yet in a position to accept many fresh orders. The foundries are taking full deliveries of iron against contracts, and are evidently desirous of accumulating stocks, and there is no sign of the usual seasonal decline in the call for iron. There is not a great deal of new business about at the moment—not because consuming works are less busy, but by reason of the fact that users have already booked ahead, and the makers are unwilling to add greatly to their commitments. Prices continue at the new levels recently established, which are based on Cleveland No. 3 at 75s. delivered Middlesbrough or Falkirk. Hematite also is moving away freely, though there is not a lot to spare when the needs of the local works have been met. Here, again, the makers are not anxious to add further to their order-books. Mixed numbers continue to be quoted at 85s. delivered North-East Coast.

LANCASHIRE.—Textile-machinery making still lacks the stimulus of a prosperous cotton industry, but engineering and other consuming works in Lancashire are busy and, together with the light-castings manufacturers, are absorbing a good tonnage of pig-iron. Annual holidays in various districts will reduce the total volume of trade for a time yet, but the delivery position so far as iron and steel is concerned is little affected and will remain favourable for a long period, according to all the signs. Derbyshire and Staffordshire brands of No. 3 iron are quoted for delivery to Lancashire users at 83s., Northamptonshire No. 3 at 81s. 6d., and Derbyshire forge at 80s. to foundries and 78s. to wrought-iron works. West Coast hematite mixed numbers are on offer at 93s. 6d. per ton, and East Coast hematite at 6d. less. Scottish No. 3 iron is in moderate request at 90s., delivered Manchester or equal.

MIDLANDS.—Most consumers of foundry iron in the Midland area covered their requirements well ahead at the old prices, and there has not yet been much business at the new rates recently established. The market is very firm. Demand from engineering works and from the light-castings and jobbing foundries is very heavy, and shows no sign of falling away. Almost without exception, the consuming works are busy and have good order-books. Prices are unchanged for common irons, but some of the better grades of iron, used chiefly by the engineering works, are dearer. Some observers anticipate a definite shortage of iron in the near future if the pressure for deliveries is maintained at the present rate. Already there is a scarcity of some grades. Demand for hematite also is maintained at a high level. Pig-iron prices are as follow:—Derbyshire, Lincolnshire and Staffordshire No. 3, 80s.; Northants No. 3, 77s. 6d.; medium-phosphorus iron, 82s. 6d. to 90s.; low-phosphorus (including Scottish No. 3), 92s. 6d. to 100s.; refined iron, £6 10s. and upwards; West Coast hematite mixed numbers, £4 17s.; East Coast No. 3, £4 16s.; Welsh mixed numbers, £4 15s. 6d., all delivered Birmingham and Black Country stations. Forge pig-iron is 5s. below the corresponding No. 3 foundry level when destined for ironworks, and 3s. below No. 3 foundry if for use in foundries.

SCOTLAND.—Light-castings establishments have resumed with good order-books, and are taking out iron at a good rate. The steelworks also are active, though there will be a slackening now with the opening of the Fair holidays. Cleveland iron is coming forward more freely. All prices stand unchanged. Scottish foundry No. 3 is 79s. f.o.t. furnaces, and No. 1 81s. 6d. Cleveland No. 3 is 75s. at Falkirk and 78s. at Glasgow. Hematite is quoted at a uniform rate of 85s. 6d., less 5s. rebate, for Scottish, East Coast and West Coast mixed numbers, delivered steelworks. Basic iron is at 75s., less rebate, delivered.

Coke

There continues to be a good demand for foundry coke and the markets are very firm indeed. Furnace coke, owing to the insistent demand for pig-iron, also is in heavy demand. Lower prices seem to be quite out of the question, and recently there has been a considerable amount of forward buying. For delivery to Birmingham and Black Country stations, best Durham foundry coke is quoted at 41s. 6d. to 43s.

Steel

In the semi-finished steel section the requirements of consumers show no signs of decreasing. The pressure to obtain supplies of British material is unrelaxed and the output of the producing works is passing into immediate consumption. An active business is being transacted in finished steel and the demand for constructional material is particularly heavy. Export inquiry has improved of late and oversea buyers are showing more interest in the market.

Scrap

The scrap market retains the somewhat quieter and easier tone which has characterised it in recent weeks. Consumption of scrap is heavy, but in the case of steel importations have rendered users somewhat independent of home supplies. Prices are nevertheless upheld. The demand for iron scrap remains good. On the North-East Coast some of the works have temporarily ceased taking local deliveries of steel scrap owing to the arrival of imported material, but the delivered price is unchanged at 57s. 6d. Good cast-iron machinery scrap is in good demand at 67s. 6d. and bigger tonnages could be disposed of at that figure, while ordinary heavy cast iron is selling freely at 65s. In South Wales the demand for heavy cast iron does not vary very much and prices are unchanged at 58s. to 60s. Light cast-iron scrap has a quiet demand at 52s. 6d. to 53s. 6d., with good cast-iron machinery scrap in foundry sizes at 62s. 6d. to 65s. Little change has taken place in the markets in the Midlands. There is a very steady demand for cast scrap, heavy machinery obtaining 70s., good heavy 65s. and clean light scrap 52s. 6d. to 55s. In Scotland, owing to holidays, machinery cast-iron scrap is not so easily disposed of at 68s. to 70s., while ordinary cast-iron scrap is about 65s. delivered.

Metals

Copper.—Quiet, but firm conditions have prevailed in the copper market during the past week. Price movements have been small. The fact that world stocks have been reduced has imparted an undertone of confidence to the market, and any price changes are expected to be in favour of sellers. The summer months make a dull period for copper, and there are unlikely to be any pronounced movements in the near future.

Daily market prices:—

Cash.—Thursday, £36 16s. 3d. to £36 17s. 6d.; Friday, £36 17s. 6d. to £37; Monday, £36 18s. 9d. to £37; Tuesday, £36 17s. 6d. to £36 18s. 9d.; Wednesday, £36 18s. 9d. to £37.

Three Months.—Thursday, £37 1s. 3d. to £37 2s. 6d.; Friday, £37 3s. 9d. to £37 5s.; Monday, £37 5s. to £37 6s. 3d.; Tuesday, £37 3s. 9d. to £37 5s.; Wednesday, £37 5s. to £37 6s. 3d.

Tin.—Prices have improved considerably this week, but the tone of the market is still somewhat uncertain. The future of the international restriction scheme continues to occupy the minds of operators, the latest development in this connection being the announcement of the Siamese Foreign Minister that Siam is willing to continue to co-operate with the other tin-producing countries if she is given a quota of 18,000 to 20,000 tons. Siam's present quota is 12,250 tons, and it is thus evident that a further period of negotiation will be required before the future of the scheme is definitely settled.

Metal Exchange quotations were as follow:—

Cash.—Thursday, £188 10s. to £188 15s.; Friday, £186 10s. to £187; Monday, £193 10s. to £193 15s.; Tuesday, £192 10s. to £193; Wednesday, £192 10s. to £193.

Three Months.—Thursday, £184 10s. to £184 15s.; Friday, £182 5s. to £182 15s.; Monday, £190 to £190 10s.; Tuesday, £187 10s. to £188; Wednesday, £188 to £188 10s.

Spelter.—Dull conditions continue in the spelter market. Prices are regarded as being comparatively low, and there are signs that buyers are beginning to show more interest in the market, but the prevailing quietness is expected to continue for some time. There is still no news of any progress concerning the renewal of the International Zinc Cartel.

Official quotations were as follow:—

Ordinary.—Thursday, £13 6s. 3d.; Friday, £13 3s. 9d.; Monday, £13 7s. 6d.; Tuesday, £13 7s. 6d.; Wednesday, £13 8s. 9d.

Lead.—Prices have fallen a little on the week, but the market still presents a firm tone. Business is not very active at the moment, but consumption is very well maintained and nothing in the nature of a setback is anticipated.

Day-to-day quotations:—

Soft foreign (prompt).—Thursday, £15 10s.; Friday, £15 10s.; Monday, £15 7s. 6d.; Tuesday, £15 7s. 6d.; Wednesday, £15 7s. 6d.

Book Review

Aluminium—Legierungen. Part II. By A. Grützner and G. Apel. Published by Verlag Chemie, G.m.b.H., Berlin, W.35. Price 40.50 Rm.

This volume is an appendix to the section "Metallurgy of Aluminium" in the 8th edition of Gmelins Handbuch der Anorganischen Chemie, and is Part II of a classified list of aluminium alloys disclosed in German, British, French, Austrian, Swiss and U.S.A. patents published between 1887 and May, 1935.

As in the previous volume, the alloys are arranged alphabetically, running in the sequence of the chemical symbols representing the elements constituting the various alloys. All the elements have a place in the formation of the system, excepting aluminium, which is, itself, the basic metal of all the alloys, and is not particularly mentioned. This section carries the classification from aluminium-titanium alloys to aluminium alloys containing bismuth, calcium, magnesium, molybdenum, nickel, antimony, titanium, vanadium, tungsten and zirconium, thus completing the series.

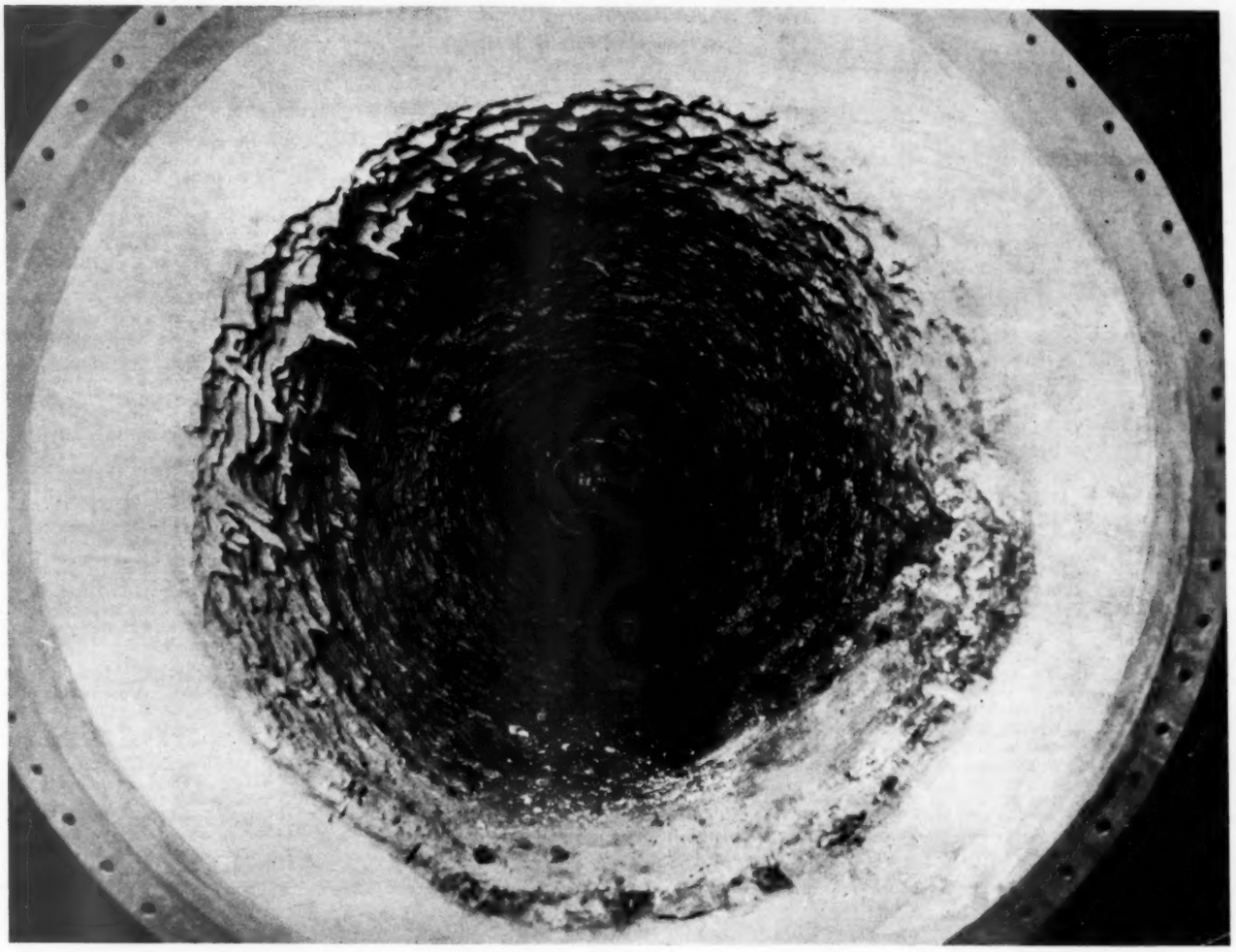
Inclusive of the alloys detailed in Part I, the total number of aluminium alloys disclosed is 12,051, and it is difficult to realise that any two authors could possibly produce such a comprehensive and accurate work, the value of which to the aluminium industry in general, and to patent agents in particular, cannot be overestimated. To patent agents the volume should be an object lesson of how many different alloy compositions it is possible to disclose in a short patent specification. British Patent Specification No. 388,109 is an interesting example. This is a short specification with a text of 108 lines, and concludes with two claims consisting of ten lines and five lines respectively. Reference to the present volume shows that this specification discloses and/or claims well over 800 different compositions which cover many pages.

The volume concludes with the trade names of between five and six hundred different alloys, together with details of composition and the name of the discoverer or manufacturer.

J. F. K.

British Foundry School

The first annual general meeting of the British Foundry School will take place at 3 p.m. on Tuesday, July 21, 1936, at the Education Offices, Margaret Street, Birmingham, by courtesy of the Chief Education Officer. The Education Offices form part of the block of Municipal Buildings at the centre of the city, and the meeting will be held in Committee Room C on the first floor. Tea will be served informally after the meeting, in the adjoining Committee Room B. All interested in the work of the School are warmly invited to be present.



950 tons of metal melted—

The above photograph shows the condition of an 04 grade Albino lining in a 5-ton Brackelsberg furnace after 255 heats. You will observe the lining has worn dark evenly and it is still approximately 8" in thickness. The 04 grade is specially produced for rotary furnaces, but there are other grades for lining cupolas, converters and ladles.
These photographs are reproduced by courtesy of James Howden and Company (Land) Ltd.

ALBINO

ROTARY FURNACE LINING MATERIAL

Please write for further particulars to the sole manufacturers:

GENERAL REFRACTORIES LIMITED,
Genefax House, Sheffield, 10

Telephone: Sheffield 31113 (6 lines) Telegrams: "Genefax, Sheffield"

MANUFACTURERS OF HEAT RESISTING AND HEAT INSULATING MATERIALS OF EVERY DESCRIPTION.

RAW MATERIALS—PRICE LIST

(Wednesday, July 15, 1936)

COPPER

	£	s.	d.
Standard cash	36	18	9
Three months	37	5	0
Electrolytic	41	0	0
Tough	39	10	0
Best selected	40	0	0
Sheets	68	0	0
India	50	0	0
Wire bars	41	5	0
Ingot bars	41	5	0
H.C. wire rods	41	15	0
Off. av. cash, June	36	7	2⅞
Do., 3 mths., June	36	13	0¼
Do., Sttlmnt., June	36	6	10⅝
Do., Electro, June	40	11	3
Do., B.S., June	39	19	2
Do., wire bars, June	40	15	4⅜
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			6¼d.

BRASS

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	8d.
Sheets to 10 w.g.	8d.
Wire	7½d.
Rolled metal	7⅜d.
Yellow metal rods	5d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5¾d.

TIN

	£	s.	d.
Standard cash	192	10	0
Three months	188	0	0
English	192	10	0
Bars	193	10	0
Straits	194	10	0
Australian (nom.)		—	
Eastern	189	7	6
Banca	194	10	0
Off. av. cash, June	183	6	10⅝
Do., 3 mths., June	181	1	2½
Do., Sttlmt., June	183	5	8½

SPELTER

	£	s.	d.
Ordinary	13	8	9
Remelted	13	5	0
Hard	11	5	0
Electro 99.9	15	8	9
English	14	7	6
India	12	10	0
Zinc dust	19	10	0
Zinc ashes	4	5	0
Off. aver., June	14	0	2½
Aver. spot, June	13	17	11

LEAD

	£	s.	d.
Soft foreign ppt.	15	7	6
Empire	16	2	6
English	17	10	0
Off. average, June	15	4	3⅜
Average spot, June	15	3	4½

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

Zinc sheets, English	23	10	0	to	24	0	0
Do., V.M. ex-whse.	23	10	0	to	24	0	0
Rods					26	0	0

ANTIMONY

English	66	10	0	to	67	10	0
Chinese, ex-whse.					51	0	0
Crude, c.i.f.					23	0	0

QUICKSILVER

Quicksilver	11	9	6	to	11	19	6

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	8 17 6
45/50%	12 15 0
75%	17 17 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	4/6 lb. Mo.
Ferro-titanium—	
20/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£21 to £22
Ferro-tungsten—	
80/85%	3/- lb.
Tungsten metal powder—	
98/99%	3/3 lb.
Ferro-chrome—	
2/4% car.	33 0 0
4/6% car.	21 10 0
6/8% car.	21 0 0
8/10% car.	21 0 0
Ferro-chrome—	
Max. 2% car.	33 10 0
Max. 1% car.	36 5 0
Max. 0.50% car.	37 5 0
70% carbon-free	9½d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£184 0 0
Ferro-cobalt, 98/99%	6/3 to 6/9 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese—	
76/80% loose	£11 5 0 to 11 15 0
76/80% packed	£12 5 0 to 12 15 0
76/80% export	(nom.) £10 5 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to ⅛ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					3	3	0
Mixed iron and steel	2	18	0	to	3	0	0
Heavy cast iron	2	18	0	to	3	0	0
Good machinery	3	2	0	to	3	5	0
Cleveland—							
Heavy steel					2	17	6
Steel turnings					2	0	0
Heavy cast iron					3	5	0
Heavy machinery					3	7	6
Midlands—							
Light cast-iron scrap	2	12	6	to	2	15	0
Heavy wrought iron					3	7	6
Steel turnings					2	0	0
Scotland—							
Heavy steel					2	17	6
Ordinary cast iron					3	5	0
Engineers' turnings					2	2	6
Cast-iron borings					1	17	6
Wrot-iron piling					3	9	6
Heavy machinery					3	9	0

London—Merchants' buying prices, delivered yard.

Copper (clean)	20	0	0
Brass	19	0	0
Lead (less usual draft)	13	10	0
Tea lead	9	0	0
Zinc	8	0	0
New aluminium cuttings	74	0	0
Brazlery copper	27	0	0
Gunmetal	28	0	0
Hollow pewter	130	0	0
Shaped black pewter	100	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—

Foundry No. 1	77/6
,, No. 3	75/-
,, No. 4	74/-
Forge No. 4	74/-
Hematite No. 1	85/6*
Hematite M/Nos.	85/-*

N.W. Coast—

Hem. M/Nos. d/d Glas.	85/6*
,, d/d Birm.	97/-*
Malleable iron d/d Birm.	125/-

Midlands (d/d Birmingham dist.)—

Staffs No. 4 forge	77/-
,, No. 3 fdry.	80/-
Northants forge	74/6
,, fdry. No. 3	77/6
,, fdry. No. 1	80/6
Derbyshire forge	77/-
,, fdry. No. 3	80/-
,, fdry. No. 1	83/-

Scotland—

Foundry, No. 1, f.o.t.	81/6
,, No. 3, f.o.t.	79/-
Cleveland No. 3, Glasgow	78/-
,, Falkirk	75/-
Scottish hem. M/Nos. d/d	85/6*

Sheffield (d/d district)—

Derby forge	74/6
,, fdry. No. 3	77/6
Lincs forge	74/6
,, fdry. No. 3	77/6
W.C. hematite	91/-*

Lancashire (d/d eq. Man.)—

Derby fdry. No. 3	83/-
Staffs fdry. No. 3	83/-
Northants fdry. No. 3	81/6
Cleveland fdry. No. 3	83/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	90/-
Clyde, No. 3	90/-
Monkland, No. 3	90/-
Summerlee, No. 3	90/-
Eglinton, No. 3	90/-
Gartsherrie, No. 3	90/-
Shotts, No. 3	90/-

* Subject to a rebate of 5s. per ton under certain conditions

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)					10	2	6
Nut and bolt iron	8	10	0	to	9	0	0
Hoops			11	0	0	and up.	
Marked bars (Staffs) f.o.t.					12	10	0
Gas strip			11	0	0	and up.	
Bolts and nuts, ¾ in. × 4 in.					15	15	0 and up.
Steel—							
Plates, ship, etc.	9	7	6	to	9	10	0
Boiler plts.	9	17	6	to	10	0	0
Chequer plts.					11	0	0
Angles					9	0	0
Tees					10	0	0
Joists					9	7	6
Rounds and squares, 3 in. to 5½ in.					10	0	0
Rounds under 3 in. to ¾ in. (Untested)					9	7	0
Flats—8 in. wide and over					9	5	0
,, under 8 in. and over 5 in.					9	10	0
Rails, heavy	8	5	0	to	8	10	0
Fishplates					12	10	0
Hoops (Staffs)					10	2	0
Black sheets, 24g. (4-t. lots)					11	10	0
Galv. cor. shts. (,,)					13	10	0
Galv. flat shts. (,,)					14	0	0
Galv. fencing wire, 8g. plain					15	0	0
Billets, soft					6	2	6
Billets, hard	7	2	6	to	7	7	6
Sheet bars					6	0	0
Tin bars					6	0	0

PHOSPHOR BRONZE

	Per lb. basis
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	12½d.
Rods	11½d.
Tubes	14d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	21.31
No. 2 foundry, Valley	19.50
No. 2 foundry, Birm.	15.50
Basic, Valley	19.00
Malleable, Valley	19.50
Grey forge, Valley	19.00
Ferro-mang. 80%, seaboard	75.00
O.-h. rails, h'y, at mill	36.37½
Billets	28.00
Sheet bars	28.00
Wire rods	38.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	1.85
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.80
Steel hoops	1.95
Sheets, black, No. 24	2.50
Sheets, galv., No. 24	3.20
Wire nails	2.10
Plain wire	2.40
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	30/- to 31/-
,, furnace	24/6 to 25/-
Durham foundry	25/- to 26/-
,, furnace	22/6
Scotland, foundry	30/-
,, furnace	25/- to 26/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14	per box	18/9
,,	28×20	,,	37/6
,,	20×10	,,	26/9 to 27/-
,,	18¾×14	,,	19/6
C.W.	20×14	,,	15/6 to 15/9
,,	28×20	,,	33/9 to 34/-
,,	20×10	,,	22/6 to 22/9
,,	18¾×14	,,	15/3 to 15/9

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6	0	0	to	£7	0	0
Bars-hammered, basis	£16	0	0	to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0	to	£16	0	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£30	0	0	to	£31	0	0
Faggot steel	£18	0	0	to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0	to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£	s.	d.		
July 9 ..	36	16	3	inc.	3/9
„ 10 ..	36	17	6	„	1/3
„ 13 ..	36	18	9	„	1/3
„ 14 ..	36	17	6	dec.	1/3
„ 15 ..	36	18	9	inc.	1/3

Electrolytic Copper

	£	s.	d.		
July 9 ..	40	17	6	inc.	2/6
„ 10 ..	40	17	6	No	change
„ 13 ..	40	17	6	„	„
„ 14 ..	40	15	0	dec.	2/6
„ 15 ..	41	0	0	inc.	5/-

Standard Tin (cash)

	£	s.	d.		
July 9 ..	188	10	0	dec.	5/-
„ 10 ..	186	10	0	„	40/-
„ 13 ..	193	10	0	inc.	140/-
„ 14 ..	192	10	0	dec.	20/-
„ 15 ..	192	10	0	No	change

Tin (English ingots)

	£	s.	d.		
July 9 ..	188	15	0	inc.	5/-
„ 10 ..	185	15	0	dec.	60/-
„ 13 ..	193	15	0	inc.	160/-
„ 14 ..	192	10	0	dec.	25/-
„ 15 ..	192	10	0	No	change

Spelter (ordinary)

	£	s.	d.		
July 9 ..	13	6	3	inc.	2/6
„ 10 ..	13	3	9	dec.	2/6
„ 13 ..	13	7	6	inc.	3/9
„ 14 ..	13	7	6	No	change
„ 15 ..	13	8	9	inc.	1/3

Spelter (Electro, 99.9 per cent.)

	£	s.	d.		
July 9 ..	15	8	9	inc.	1/3
„ 10 ..	15	6	3	dec.	2/6
„ 13 ..	15	10	0	inc.	3/9
„ 14 ..	15	7	6	dec.	2/6
„ 15 ..	15	8	9	inc.	1/3

Lead (soft foreign, prompt)

	£	s.	d.		
July 9 ..	15	10	0	inc.	2/6
„ 10 ..	15	10	0	No	change
„ 13 ..	15	7	6	dec.	2/6
„ 14 ..	15	7	6	No	change
„ 15 ..	15	7	6	„	„

Lead (English)

	£	s.	d.		
July 9 ..	17	10	0	No	change
„ 10 ..	17	10	0	„	„
„ 13 ..	17	10	0	„	„
„ 14 ..	17	10	0	„	„
„ 15 ..	17	10	0	„	„

AVERAGE MONTHLY PRICES OF FURNACE COKE D/D MIDDLESBROUGH

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1904	0 13 9	0 13 9	0 13 3	0 14 3	0 14 6	0 14 3	0 14 3	0 14 3	0 14 3	0 14 0	0 14 0	0 14 6	0 14 1½
1905	0 14 9	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 9	0 15 9	0 17 0	0 15 5½
1906	0 17 6	0 17 6	0 17 0	0 17 0	0 17 0	0 16 6	0 17 0	0 17 0	0 18 3	0 18 6	0 19 0	1 0 0	0 17 8½
1907	1 4 6	1 5 0	1 5 0	1 0 6	1 2 0	1 1 0	1 1 0	1 1 0	1 2 0	1 1 6	1 0 0	0 17 0	1 1 8½
1908	0 16 0	0 16 0	0 15 6	0 16 0	0 16 3	0 16 0	0 15 6	0 15 6	0 15 6	0 15 3	0 16 0	0 16 0	0 15 9½
1909	0 16 0	0 15 3	0 15 0	0 14 9	0 15 6	0 15 9	0 15 6	0 15 6	0 16 6	0 17 0	0 17 6	0 17 0	0 15 11½
1910	0 18 4½	0 18 6½	0 18 0	0 18 0	0 17 10½	0 17 0	0 16 1½	0 15 9½	0 15 11	0 16 0	0 15 9½	0 15 8	0 16 11
1911	0 16 0	0 15 10½	0 15 6	0 15 3	0 14 9	0 14 6	0 14 6	0 14 6	0 14 6	0 14 11½	0 15 0½	0 16 3½	0 15 1½
1912	0 17 3	0 17 3	0 18 6	0 18 10	0 19 0	0 19 4½	0 19 10½	1 0 9½	1 2 9	1 4 1½	1 5 8½	1 8 6	1 1 0
1913	1 5 9	1 4 11	1 5 0	1 5 0	1 4 9½	1 0 4½	0 19 5½	0 18 3	0 18 0	0 18 2½	0 18 6	0 18 6	1 1 4½
1914	0 18 2	0 17 1	0 17 0	0 17 0	0 17 4	0 17 6	0 17 6	0 18 5	0 18 4	0 17 9	0 17 6	0 18 5	0 17 8
1915	0 17 10½	0 17 9	1 0 4½	1 7 7½	1 9 4½	1 10 7½	1 9 7	1 7 3	1 5 4	1 4 9	1 9 6	1 13 0	1 6 1
1916	1 10 9	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6½
1917	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 14 3	1 15 6	1 11 2½
1918	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6
1919	1 15 6	1 15 6	1 15 6	1 15 6	2 1 6	2 1 6	2 3 9	2 10 6	2 10 6	2 10 6	2 10 6	2 10 6	2 3 5
1920	2 12 3	2 14 0	2 19 0	2 19 0	3 3 8	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 2 6
1921	3 1 0½	2 19 0	2 16 0	2 7 0	2 6 6	2 6 6	2 0 6	2 0 0	1 13 11	1 12 9	1 10 4½	1 8 3	2 3 6½
1922	1 7 0½	1 8 1½	1 9 7½	1 8 4½	1 7 11½	1 7 3	1 6 9½	1 6 10½	1 7 0½	1 10 2½	1 10 0	1 9 11½	1 8 3½
1923	1 11 3	1 14 6	2 0 1½	2 2 8½	2 4 4½	2 2 10½	2 1 0½	2 1 6	2 0 9½	1 18 9	1 18 8½	1 18 3	1.19 7½
1924	1 16 6½	1 14 9	1 11 11½	1 10 0½	1 8 1½	1 7 8½	1 7 3	1 6 3	1 6 0	1 5 0	1 5 0	1 5 0	1 9 6½
1925	1 4 10½	1 4 1½	1 13 3	1 2 4½	1 2 2½	1 1 5½	1 1 3½	1 4 9	0 18 10½	0 18 4½	0 19 6½	1 1 4½	1 2 8½
1926	1 2 1½	1 0 9	0 19 2½	0 18 6½	*	*	*	*	*	*	*	1 5 0	*1 1 1½‖
1927	1 5 6	1 4 9½	1 6 1½	1 3 9	1 2 6	1 0 8½	0 19 4½	0 19 0	0 18 7½	0 18 0	0 17 10½	0 17 6	1 1 1½
1928	0 17 6	0 17 10½	0 18 0½	0 17 11½	0 17 8½	0 17 6½	0 17 7½	0 17 6½	0 17 6	0 17 7½	0 17 7½	0 17 6	1 1 1½
1929	0 17 7½	0 18 0	0 19 0	0 19 6½	0 18 10½	0 19 10½	1 1 3½	1 1 8½	1 3 0	1 3 6	1 3 8	1 3 1½	0 17 8
1930	1 2 0½	1 1 3	1 0 3	0 19 1½	0 17 7	0 16 10½	0 16 6	0 16 6	0 16 9	0 17 0	0 17 0	0 17 0	1 0 9½
1931	0 17 0	0 16 7½	0 16 0	0 16 0	0 15 11	0 15 5	0 15 1	0 15 0	0 15 0	0 16 9	0 17 0	0 16 6	0 16 2½
1932 ..	0 17 0	0 16 11½	0 16 5½	0 15 9	0 15 7½	0 15 6	0 15 6	0 14 9½	0 14 6½	0 14 6	0 14 6	0 16 6	0 16 0½
1933 ..	0 16 0½	0 15 11½	0 15 6½	0 15 6	0 15 6	0 15 6	0 15 6	0 15 8½	0 16 1½	0 17 0	0 17 6	0 18 0	0 16 1½
1934	0 19 1½	1 0 6	1 0 2	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	0 19 11½
1935	1 0 0	0 19 6½	0 19 0½	0 19 0	0 19 0	0 19 0	0 19 0	0 18 9½	0 18 9½	0 18 9½	0 19 3½	1 1 2½	0 19 2½
1936	1 2 0	1 2 11½	1 3 2½	1 4 0	1 4 11½	1 4 3½	—	—	—	—	—	—	—

* Strike period. ‖ Five months.

WILLIAM JACKS & COMPANY,

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CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

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REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

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COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

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ZETLAND ROAD, MIDDLESBROUGH.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

EXPERT Foundry Manager, ferrous and non-ferrous, open to re-engagement; guarantee excellent results.—Apply Box 774, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRYMAN, practical, technical and commercial experience, wishes to represent first-class firm for sale of ferrous and non-ferrous castings in Birmingham and Midlands.—Box 808, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Manager (age 41 years) seeks position; 25 years' practical and technical experience in steel, iron and non-ferrous founding, possessing first-class knowledge of metallurgy, general furnace practice, sand control, latest methods of machine and plate moulding. Good organiser and strict disciplinarian. First-class testimonials, etc. Will consider a post abrpad.—Box 810, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Superintendent for North-East Coast. Light castings, pipes, etc. Only those with wide experience of modern methods need apply. State age, experience, and salary required, to Box 802, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PLUMBERS' Brass Foundry. Man required in Birmingham to take charge of foundry and casting shop and rough warehouse. Must be conversant with up-to-date methods and experienced in handling unskilled labour on machine moulding. Progressive and permanent position for real live man.—Box 806, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PRODUCTION Engineer wanted by firm of cooking and heating appliance makers in the Midlands. Some knowledge of time and motion study essential. Experience in any or all of the following an advantage: Light castings, machine moulding plants, porcelain enamelling, press work and general assembly. State age, salary required, and full experience, in confidence, to Box 804, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

REQUIRED, a well-experienced Moulder used to medium and heavy castings, to act as Foreman. State fully experience and wages to Box 812, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SALES and Estimating Engineer, thoroughly experienced in electric-furnace industry. Excellent opportunity for first-class man. Give full particulars technical education, experience, age, and salary required. Replies treated in strict confidence.—Box 786, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

STEELFOUNDRY Foreman wanted with experience in light and alloy-steel castings, used to modern methods and some technical knowledge. An excellent opportunity with prospects for right man. Write giving age, experience, and salary required, to Box 784, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SITUATIONS VACANT AND WANTED.—*Contd.*

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

ASSISTANT Foundry Manager desires re-engagement. Experience includes in charge of highly mechanised plant, also general engineering jobbing experience. Fully competent to control metal mixtures, cupola management. Has had some laboratory experience. Sound technical training. (279)

FOUNDRY Manager requires position or as Assistant. Young, practical moulder, excellent experience in managerial positions on general engineering and also repetition work. Cupola control. Sound technical training. (281)

MANAGER, age 40, practically and metallurgically highly qualified Engineer with 15 years' experience in large iron, steel, brass and aluminium foundries, desires responsible position with well reputed firm. (282)

BUSINESS FOR SALE

TO be sold as a going concern, a well-established London Ironfoundry, complete with plant and equipment, with the benefit of orders in hand. Good connections have been established and a steady output has been secured. An opportunity of a lifetime for a good practical foundryman capable of producing castings of good quality. Purchase terms may be arranged.—Apply W. J. LEEMING, Chartered Accountant, Victoria House, Southampton Row, London, W.C.1.

MACHINERY

Tilghman Sandblast Barrel Plants; barrel sizes—60 in. x 40 in.; 36 in. x 20 in.; 20 in. x 30 in.

Tilghman Sandblast Cabinet Plants; 4 ft. 6 in. and 3 ft. 6 in. square (one for high pressure 70 lbs. per sq. in.); also small Cabinet 30 in. dia.

All complete with Air Compressors, etc.

Gas and Air Mixer by Sharpe & Preston, 2-in. outlet.

Six Osborne Pneumatic Jolt Press Moulding Machines, size 75J.

Three Mumford Yoke Headpress Pneumatic Moulding Machines.

Two Herbert Whizzer Sand Disintegrators.

Two Brealey Type ditto.

Heavy Double-ended Grinding Machines by Rowlands, Luke & Spencer, etc.

Hand Moulding Machines by Adaptable Darling & Sellars, Pridmore, Samuelson, etc.

500 Electric Motors, Dynamos, Rotary Converters, etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD LTD.

"Pridmore" Pneumatic MOULDING MACHINE; type "EV"; take boxes 3' 6" x 2'.

Inclining TUMBLING BARREL (Canning); 22" dia. barrel x 18" deep; 50 r.p.m.; 12" dia. F. & L. pulleys.

Three VERT. COCHRAN BOILERS; 16' 6" x 8'; 100 lbs. w.p.

Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued*

WANTED.—Rotary Melting Furnace, 1 ton capacity. Also power Riddling Machine.—Box 800, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1936 edition. Price 42s. cloth bound, 52s. Morocco. Order your copy now.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

MISCELLANEOUS

FIRM of Ironfounders open to purchase grey-iron alloy specifications for high-duty irons; also receive offers of representative for sale of same.—Box 772, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

TRY Southport Sand, the best for Cores. Quick deliveries by road. Any quantity. Sample free.

JOHN LIVESEY,
SAND MERCHANT,
SOUTHPORT.

'Phone: 287 SLOUGH

MOULDING MACHINES

Two Tabor Modern Jolt Squeeze and Pattern Draw Machines for boxes 20" × 14"; as new. Price £65 each.

One ditto, for 20" square Boxes. Price £70.

Several reconditioned GRIMES Hand Pattern-draw and Turnover Machines. Price £12 each.

One genuine OSBORN Hand Machine. Price £28.

Several nearly new DENBIGH Jolters. CHEAP!

CUPOLETTE, 30" dia., NEW. Price £26.

PLEASE SEND US YOUR ENQUIRIES.

ALEX. HAMMOND, *Foundry Machinery Merchant,*
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BUY FROM ME AND SAVE MONEY!

SELECT YOUR MACHINE FROM THE LARGEST STOCK OF HIGH-CLASS SECONDHAND MOULDING MACHINES IN THE WORLD

Practical Advice Free

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